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THE REVIEW OF APPLIED ENTOMOLOGY.

SERIES B: MEDICAL AND VETERINARY.

VOL. 36.
(1948.)

ISSUED BY THE COMMONWEALTH INSTITUTE OF ENTOMOLOGY.

LONDON:
COMMONWEALTH INSTITUTE OF ENTOMOLOGY,
41, QUEEN'S GATE, S.W.7.
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ERRATA

Page 11 line 10 for " **35** 141 " read " **34** 141 "

,, 13 6 lines from end for " Rude (C. A.) " read " Rude (C. A. [*i.e.* C. S.]) "

,, 26 line 28 for " **25** 50–52 " read " **25** 51–52 "

,, 117 line 10 for " cyclohexanone " read " cyclohexenone "

,, 128 line 4 for " *B.* (*Periplaneta*) *orientalis* " read " *Blatta* (*Periplaneta*) *orientalis* "

,, 133 5 lines from end for " Khatoum " read " Khartoum "

,, 139 line 14 for " host species " read " both species "

,, 151 2 lines from end for " isositol " read " inositol "

,, 158 10 lines from end for " Flensburg (1913) " read " Flensburg (1911) "

,, 161 line 5 for " Krüpe " read " M. Krüpe "

COMMONWEALTH INSTITUTE OF ENTOMOLOGY.

REVIEW
OF
APPLIED ENTOMOLOGY.

SERIES B.

Vol. 36. 1948.

WATSON (R. B.). **On the Probability of Soldiers with Pacific *Plasmodium vivax* Malaria infecting** *Anopheles quadrimaculatus*.—*J. nat. Malar. Soc.* **4** no. 3 pp. 183–188. Tallahassee, Fla., 1945.

In experiments to determine the probability of Pacific strains of *Plasmodium vivax* being transmitted in the United States by *Anopheles quadrimaculatus*, Say [*cf. R.A.E.*, B **35** 49], lots of about 25 newly emerged females were fed on patients having relapsing infections with *P. vivax* presumably acquired in Pacific war areas. The term relapse is used for the reappearance of parasitaemia, with or without clinical expression. The relapse rate of the largest group of patients who had acquired infection in one place was 0·73 per month. Other rates were not dissimilar. After feeding, the mosquitos were incubated at 75 82°F. with a relative humidity of about 85 per cent. The salivary glands of all those that died after an incubation period of 11 days were examined for sporozoites, and all those remaining at the end of 15 days were similarly examined.

An over-all infection rate of 11·8 per cent. was found in 1,426 females that had been fed in 117 experiments, representing 87 different patients. The infection rate (17·7 per cent.) in lots of mosquitos fed on patients with asymptomatic parasitaemia was higher than that in mosquitos fed on patients who were clinically ill. The infection rates for females fed on patients who had previously received two 0·6 gm. doses of quinine or totaquine six hours apart were not significantly different from those fed on patients who had received no treatment. Patients seemed to be most infective for mosquitos while they were experiencing their sixth to 15th relapses. The chances of a mosquito becoming infected tended to vary directly with the number of gametocytes in the infecting blood-meal. It is concluded that many, if not all, strains of *P. vivax* from Pacific war areas can be transmitted by *A. quadrimaculatus* and that soldiers returning with such infections may be responsible for the establishment in the United States of epidemic or endemic foci of imported strains of *P. vivax*.

FELLTON (H. L.), BARNES (R. C.) & WILSON (A.). **Malaria Control in a non-endemic Area.**—*J. nat. Malar. Soc.* **4** no. 3 pp. 201–208, 16 refs. Tallahassee, Fla., 1945.

The history of malaria in the north-eastern United States is briefly reviewed, and anti-malarial measures in this area necessitated by the return of service

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personnel to the United States and the introduction of prisoners of war from all parts of the world are discussed. It is thought that there is no danger of the re-establishment of endemic malaria in these States, but that precautions to forestall or control any outbreaks that may occur are advisable. The chief ones are the establishment of mobile mosquito-control units at strategic centres, the making of extensive Anopheline surveys round places where returning service personnel and prisoners of war are gathered, control of Anophelines where concentrations of human carriers and the vector occur, and educational activities.

The results of surveys of *Anopheles quadrimaculatus*, Say, made at adult resting stations in the north-eastern States in 1943–44 are summarised in a table. *A. quadrimaculatus* was present in 32 of the 57 areas studied and occurred in each of the nine States surveyed. In five States in which resting-station counts were made, it comprised more than half of the Anopheline population. High single station counts included 200 in Massachusetts, 500 in Rhode Island, 525 in Delaware and 1,000 in New York. High densities are probably found in all the north-eastern States, with the possible exception of Maine, Vermont and New Hampshire. *A. quadrimaculatus* was found in diurnal shelters from late May until mid-October in Massachusetts, and both males and females were taken on 1st June, 1944, under a bridge near a marsh where breeding had been considerable during the previous season. It is generally accepted that males do not survive the winter. Control measures were limited to the application of larvicides to breeding places, with clearing and cleaning as adjuncts where necessary, and minor drainage operations.

KIKER (C. C.) & SPARKMAN (R. E.). **A Review of Equipment used in applying Malaria Control Measures on impounded Waters in the Tennessee Valley.**—*J. nat. Malar. Soc.* **4** no. 3 pp. 209–222, 9 figs., 1 ref. Tallahassee, Fla., 1945.

A review is given of the mechanical devices and spraying and miscellaneous equipment used on and near the impounded waters of the Tennessee River Valley in the practice of malaria control measures directed against *Anopheles quadrimaculatus*, Say. The principal measures are removal of timber and other growth before impoundage, drainage of depressions in the zone of water level fluctuation, periodical removal of objectionable marginal vegetation after impoundage, and the supplementary use of larvicides and insecticides against the adult mosquitos [*cf. R.A.E.*, B **30** 161; **33** 124; **34** 139].

CAUSEY (O. R.). **Description of** *Anopheles* (*Nyssorhynchus*) *dunhami*, **a new Species from the Upper Amazon Basin.**—*J. nat. Malar. Soc.* **4** no. 3 pp. 231–234, 5 figs. Tallahassee, Fla., 1945.

Descriptions are given of the egg, larva and adults of both sexes of *Anopheles dunhami*, sp. n., a member of the "*tarsimaculatus* complex" of the *Nyssorhynchus* group of *Anopheles* that was taken in large numbers on animal bait in Tefé, Amazonas, Brazil. Malaria is not prevalent in the area. As regards the egg, larva and adult colour pattern, *A. dunhami* is similar to *A. goeldii*, Rozeboom & Gabaldon, but the male terminalia distinguish it from that species and from *A. nuñez-tovari*, Gabaldon.

MILES (V. I.). **Differentiating the Larvae of** *Anopheles georgianus* **King,** *A. bradleyi* **King, and** *A. punctipennis* **(Say).**—*J. nat. Malar. Soc.* **4** no. 3 pp. 235–242, 3 figs., 3 refs. Tallahassee, Fla., 1945.

The characters given by King [*R.A.E.*, B **28** 45], King, Bradley & McNeel [**31** 232] and Matheson [**33** 114] for separating larvae of *Anopheles crucians georgianus*, King, and *A. c. bradleyi*, King, which are here considered distinct

species, from each other and from those of *A. punctipennis*, Say, are quoted, and the need for additional characters is pointed out. As a result of a study of 55 mounted fourth-instar larvae of *A. c. georgianus* from 19 localities in the coastal States from North Carolina to Louisiana, 53 of *A. c. bradleyi* from ten localities in coastal States from Virginia to Texas, excluding North Carolina and Louisiana, and 58 of *A. punctipennis* from 17 localities in seven south-eastern States and Washington, D.C., supplementary characters for separating *bradleyi* from *georgianus* and from *punctipennis* are given and discussed. A key for distinguishing the three types of larvae is also included. Variations in the character differences in the three forms, expressed as percentages of the total number of each character present and visible in the series of larvae studied, are given in a table, and differences between the authors' findings and those of other workers are indicated.

CAUSEY (O. R.), DEANE (L. M.) & DEANE (M. P.). *Anopheles aquasalis vs. Anopheles tarsimaculatus* **as the Name for the brackish Water Anopheline of Central and South America and the Caribbean Islands.**—*J. nat. Malar. Soc.* **4** no. 3 pp. 243–250, 18 refs. Tallahassee, Fla., 1945.

The validity of the name *Anopheles tarsimaculatus*, Goeldi, for a species of the subgenus *Nyssorhynchus* with a black ring on the fifth segment of the hind tarsus, is discussed. It is pointed out that at least three species of the *Nyssorhynchus* group corresponding to Goeldi's meagre descriptions are present in the areas from which he collected his material, and it is shown that he used the name for several species. In view of this and the fact that *tarsimaculatus* was illegally proposed [*R.A.E.*, B **29** 181], the authors consider that it is not available as a name for any Anopheline. The mosquitos in Belém designated as *Anopheles tarsimaculatus* by Galvão and others [**32** 91] and described as *A. emilianus* by Komp [**30** 146] are indistinguishable in morphological and physiological characters from *A. aquasalis*, Curry. They had been differentiated from the latter mainly by the egg, the male terminalia not being considered particularly distinctive by Komp [**30** 146]. Study of more than 7,000 egg batches laid by isolated females showed considerable variation in the type of egg. In Ceará, where the climate is drier, the floats are more closely approximated than in Belém, where there is a greater tendency for the floats to be separated. Even among eggs of the same batch, however, both types can be seen. Variations in the male genitalia as great as the differences described by Komp between *emilianus* and *aquasalis* may be found among individuals arising from the same batch of eggs. *A. emilianus* is therefore considered a synonym of *A. aquasalis*.

This species has been collected along the coastal region of Brazil from Rio de Janeiro to the border of French Guiana, always in areas influenced by tidal sea water. Extensive searches in the Amazon region have revealed that it does not exist in the interior from Belém. Although it can mature in fresh water, it usually breeds in brackish water. Larvae can mature in sea water in the laboratory. In one experiment, larvae continued to grow and pupated in sea water that was allowed to evaporate until it reached a concentration of 7·4 per cent. sodium chloride.

A list is given of the mosquitos of the subgenus *Nyssorhynchus* with a black ring on the fifth hind tarsal segment that have been described, showing which names are valid and which are synonyms. All the valid species except *A. albimanus*, Wied., have been found in the north-eastern and Amazon regions of Brazil. The list includes *A. goeldii*, Rozeboom & Gabaldon, but not *A. nuñez-tovari*, Gabaldon [of which it is considered a synonym by Cova-García (**35** 136)].

Bradley (G. H.) & Fritz (R. F.). **Observations on seasonal Occurrence and Abundance of** *Anopheles quadrimaculatus* **Say.**—*J. nat. Malar. Soc.* **4** no. 3 pp. 251–262, 12 figs. Tallahassee, Fla., 1945.

Generalisations on the length of the season of activity of *Anopheles quadrimaculatus*, Say, in the different isothermal zones of the United States (zones divided by isotherms drawn at intervals of 5°F.) are given in graphs prepared from data obtained during three years' entomological survey work of the Malaria Control in War Areas programme. The warmest isothermal zone is 70–75°F. Significant densities of adults (ten or more in any resting place) occurred throughout the year and more than 100 in a resting place were found continuously during the eight warmer months in zones 65 70° and 70–75°. One station in the former zone harboured 4,000 adults and one in the latter 2,500. In zones 60–65°, 55–60° and 50–55°, ten or more adults were observed in individual resting places for 8, 5½ and slightly less than 5 months and more than 100 for less than 6, 4½ and 4 months, respectively. A maximum population of over 9,000 was reported for zone 50–55°. The areas of the eastern United States in which malaria is endemic are included between isotherms 60 and 75°F. In the more northerly zones, high densities of *A. quadrimaculatus* occurred at the beginning and nearly the end of the active season, and abundance was sometimes greater than it was further south where the season of activity was much longer.

In another graph, the percentage of localities under observation in zone 65–70° in which significant densities of *A. quadrimaculatus* occurred is shown for each week during 1943 and 1944. Four examples demonstrate how adult densities and the length of the season of activity in any specific locality may vary from the composite pattern for the zone. The danger of estimating the conditions likely to occur in any individual locality from surveys of short duration and the importance of entomological surveillance are indicated.

Keener jr. (G. G.). **Detailed Observations on the Life History of** *Anopheles quadrimaculatus*.—*J. nat. Malar. Soc.* **4** no. 3 pp. 263 270, 3 figs., 4 refs. Tallahassee, Fla., 1945.

Information regarding the life-cycle and habits of *Anopheles quadrimaculatus*, Say, at relative humidities of 70 80 per cent., air temperatures of 76 80°F. and a water temperature of about 74°F. was obtained during routine management of an insectary colony in Alabama [*cf. R.A.E.*, B **28** 218]. The mean time required for development from oviposition to adult emergence was 21 days with a minimum of 14 and a maximum of 27 [*cf.* **32** 31, **33** 81], and the mean durations of both the egg and pupal stages were two days. The mean and maximum durations of adult life were 7 and 21 days in males and 21 and 62 days in females. The sexes emerged in about equal numbers, but the peak of emergence of males was earlier than that of females. Pairing, which took place in a cage 24 ins. long, 18 ins. high and 10 ins. wide, usually at about 8 p.m., is described. Apparently it may occur at any time after emergence. Fertile eggs were deposited by females that paired only before or only after their first blood-meal. Though females may pair several times, one insemination apparently enables them to produce viable eggs throughout life. One female deposited five fertile batches of eggs over a period of 17 days following a single insemination. Females took blood-meals as early as 18–20 hours after emergence and rarely took more than one on the same day. The total number per female averaged 9·4. Feeding took place to some extent during the day but rapidly increased immediately after the onset of darkness and reached a peak near the end of the night. Females deposited eggs while resting on the surface of the water or on some object near the water's edge. Oviposition began as little as 80 hours after emergence and usually took place 60 hours

after a blood-meal. It occurred exclusively at night and reached a peak immediately after the onset of darkness. In observations on oviposition by five females, the average number of eggs per batch was 219, and some females oviposited 9–12 times. Detailed records for some 300 females showed a total production of almost 200,000 eggs.

Causey (O. R.), Deane (L. M.) & Deane (M. P.). **Studies on Brazilian Anophelines from the Northeast and Amazon Regions. I. An illustrated Key by adult female Characteristics for the Identification of thirty-five Species of Anophelini, with Notes on the Malaria Vectors (Diptera, Culicidae). II. An illustrated Key by male genitalic Characteristics for the Identification of thirty-four Species of Anophelini, with a Note on Dissection Technique. III. An illustrated Key by larval Characteristics for the Identification of thirty-two Species of Anophelini, with Descriptions of two Larvae.**—*Monogr. Ser. Amer. J. Hyg.* no. 18, vii+50 pp., 20 pls., refs. Baltimore, Md., Johns Hopkins Press, 1946. Price $1.10.

Studies made in 1939–43 in the north-east and Amazon regions of Brazil revealed the presence of two species of *Chagasia* and 33 species of *Anopheles* including *A. gambiae*, Giles, which has since been eradicated [*R.A.E.*, B **32** 28–30, 159, etc.]. These are dealt with in the present monograph, and the more recently described *A. dunhami*, Causey [**36** 2] is included in the key to the males. Besides the keys and other information mentioned in the title, tables showing additional differential characters for the females of species belonging to the *tarsimaculatus* complex and the distribution of the 35 species within the two regions are contained in the first part, schematic drawings showing the general morphology of the genitalia in the second, and data on the distribution and breeding places of the 30 species of *Anopheles* and two of *Chagasia* studied in the larval stage in the third. The two larvae described are *A. galvãoi*, Causey, Deane & Deane, and *A. shannoni*, Davis.

The principal malaria vectors apart from *A. gambiae*, Giles, were found to be *A. aquasalis*, Curry, and *A. darlingi*, Root; *A. albitarsis*, Arrib., and *A. pessôai*, Galvão & Lane, are secondary vectors. Notes are given on their habits and relative importance. Slight differences in the morphology and striking differences in the biology of *A. albitarsis* from various areas indicated that there may be an "*albitarsis* complex" composed of several species. The varieties of *albitarsis* recognised by Galvão included one that he and Lane called *albitarsis limai* [**26** 184], and another that he and Damasceno designated as *albitarsis domesticus* in 1942. The former is common in the interior of São Paulo and usually does not invade houses, while the latter invades houses in large numbers; the two differ in the colour of the second hind tarsal segment, of which 70–90 per cent. is black in *limai* and 40–50 per cent. in *domesticus*. A third form has been observed by the authors in Ceará, where it is the most widely distributed and in many areas the most abundant Anopheline. It rarely enters houses but differs from *limai* in that only 25–45 per cent. of the second hind tarsal segment is black. It comprised 97·6 per cent. of the Anophelines taken out-of-doors and 4·3 per cent. of those taken in houses in extensive studies in Cumbe, Ceará. Most of those found in houses were in buildings with brilliant lights. This form is shown to be a poor vector of malaria by the lack of immunity among the inhabitants of the Jaguaribe Valley when *A. gambiae* invaded the region. Even after the epidemic caused by *A. gambiae* in Cumbe, none of the 314 females of *albitarsis* dissected was found infected. Moreover, *A. gambiae* became abundant without causing malaria in Madalena, deep in the interior of Ceará, where *albitarsis* was the most prevalent mosquito, and this could only have happened where the indigenous mosquitos were such poor vectors that the disease did not

exist. The form of *A. albitarsis* found in many parts of the north-eastern and Amazon regions other than Ceará can be taken in houses in large numbers both by day and night, and as it has a broader black band on the second hind tarsal segment, it may correspond to *A. a. domesticus*. It is not believed to be an important vector of malaria in most areas studied by the authors. In an area of Paraíba with high malaria endemicity and an area of Pará with low endemicity, *A. albitarsis* was the only Anopheline abundant in houses and was probably the vector. One female out of 201 was found infected with oöcysts in the former and one out of 489 was infected in the latter.

BRETT (C. H.). **Insecticidal Properties of the Indigobush** (*Amorpha fruticosa*).—*J. agric. Res.* **73** no. 3 pp. 81–96, 5 figs., 13 refs. Washington, D.C., 1946.

The author describes investigations on the insecticidal properties of *Amorpha fruticosa*, a leguminous plant that gave colour reactions thought to indicate the presence of rotenone in the roots, stems, bark and seeds, but was subsequently found to contain a glycoside reacting to the rotenoid tests [*cf. R.A.E.*, A **32** 222]. The toxic principle (here termed amorpha) has not been determined, but it occurs chiefly in resinous pustules on the pods, these pustules varying greatly in size and abundance. Fruits from individual plants were tested biologically as a guide to the selection or breeding of plants to give a high yield of insecticide.

In laboratory tests with sprays, generally aqueous emulsions prepared by adding standardised acetone extracts of the unground fruits to distilled water, and dusts, prepared by pouring an acetone extract into walnut-shell flour, stirring until most of the acetone had evaporated and allowing to dry [*cf.* also A **36** 9], dusts gave more than 80 per cent. control of larvae of *Aëdes aegypti*, L., but none of *Dermanyssus gallinae*, Deg., and dusts and sprays were ineffective against house-flies (*Musca domestica*, L.).

A dust rubbed into the hair of dogs infested by *Ctenocephalides canis*, Curt., caused over 70 per cent. of the fleas to drop off within three hours though there was no significant toxic effect, and it was found by other workers that a spray killed cattle grubs [*Hypoderma*] on cattle [*cf.* B **33** 101] and that a dust gave about 50 per cent. mortality of *Haematopinus eurysternus*, Nitzsch. Amorpha repelled house-flies in the laboratory, and sprays in oil applied to cattle repelled flies, including *M. domestica* and *Siphona* (*Haematobia*) *irritans*, L., for about 12 hours. In aqueous extracts injected into *Periplaneta americana*, L., amorpha was about one-tenth as toxic as derris containing 4·7 per cent. rotenone. A test with guineapigs indicated that it would probably be poisonous to mammals if taken internally, but no effect was noted on the skin.

ZIMMERMAN (O. T.) & LAVINE (I.). **DDT—Killer of Killers.**—8×5½ ins., xi+180 pp., 24 figs. Dover, N.H., Industr. Res. Serv., 1946. Price $3.

The authors give a popular survey of the discovery of DDT, its development as an insecticide, its chemical and physical properties, its toxicity to vertebrate animals and its insecticidal action, the forms in which it is available for insecticidal purposes, its use against a number of common pests of medical, veterinary or agricultural importance, and its effect on beneficial insects. An introductory chapter deals in a general manner with several of the more important Arthropod-borne diseases, and appendices contain brief instructions for the application of DDT against some common Arthropods that attack man and domestic animals or infest buildings, and against agricultural and forest pests.

BISHOPP (F. C.). **The Insecticide Situation.**—*J. econ. Ent.* **39** no. 4 pp. 449–459, 28 refs. Menasha, Wis., 1946.

The author gives an account of developments that took place in the use of insecticides in the United States during the war years, largely owing to the shortages of the materials formerly used. The plant formerly reported as *Erigeron affinis* [*cf. R.A.E.*, B **34** 191] has been found by E. L. Little & S. F. Blake to be almost certainly *Heliopsis longipes* ; root material was found to be highly toxic to the active forms but not the eggs of the body louse [*Pediculus humanus humanus*, L.] and not toxic to larvae of *Anopheles quadrimaculatus*, Say, or to Trombiculids (chiggers). Sabadilla [*cf.* **33** 65] was found to give complete mortality or paralysis of *Pediculus* on exposure to treated cloth for 11 days or longer after treatment, with a knockdown time of 1–3 hours, but it had no appreciable ovicidal effect. It was fairly effective against Trombiculids exposed on treated cloth, but the effect was largely lost on rinsing. The addition of 10 parts per million of sabadilla to water in which larvae of *A. quadrimaculatus* were developing caused 50–95 per cent. mortality. Material prepared from the plant, *Ryania speciosa*, was not promising as compared with DDT in tests against *Pediculus*, flies [*cf.* **33** 128] and mosquito larvae, although it killed 50–95 per cent. of *Anopheles* larvae when added to water at 10 p.p.m.

The synthetic organic compound 2′-hydroxy-2,4,4,4′,7-pentamethylflavan, applied at 2–5 lb. per acre in a spray and at 4–8 lb. per acre in a dust, reduced the numbers of Trombiculids in the soil by 81–100 and 96–100 per cent., respectively, for periods of 1–2 months, but it did not give promising results against *Pediculus*. This compound is said to be less toxic to warm-blooded animals than DDT. Crude benzene hexachloride was highly effective against the motile forms of *Pediculus* and was reasonably persistent when applied as a 5 per cent. powder ; it was not markedly ovicidal. The γ isomer gave 50–100 per cent. kill of larvae of *A. quadrimaculatus* when added to the water in which they were developing at 0·01 p.p.m. Benzene hexachloride was the most effective of 75 compounds tested against Trombiculids by application to infested soil, causing almost complete eradication when applied at about 10 lb. commercial material (10–12 per cent. γ isomer) per acre in Florida and 89–100 per cent. reduction in population when applied at 2–5 lb. commercial material per acre in Georgia. It has been found that 1,1-dichlor-2,2-bis(parachlorphenyl) ethane, which has been referred to as DDD, TDE and Rothane, is slower in knockdown and much less persistent in action against *Pediculus* than DDT, but more toxic to *Anopheles* larvae, giving 50–100 per cent. kill in acetone suspension at 0·0025 p.p.m. The methoxy or anisyl analogue of DDT, 1,1,1-trichlor-2,2-bis(paramethoxyphenyl)ethane [*cf.* **33** 120] gave somewhat erratic results when tested against fourth-instar larvae of *Anopheles* ; at 0·005 p.p.m. it gave 20 per cent. kill in 48 hours, as compared with 93 per cent. for DDT. It was less effective than DDT but showed some promise as a residual spray against house-flies [*Musca domestica*, L.] and mosquitos. The bromine analogue, 1,1,1-trichlor-2,2-bis(parabromophenyl)ethane, at 0·0025 p.p.m. killed 60 per cent. of *Anopheles* larvae in 24 hours, as compared with 22 per cent. for DDT, and 95 per cent. in 48 hours as compared with 80 per cent. for DDT. The fluorine analogue, 1,1,1-trichlor-2,2-bis(parafluorophenyl)ethane, was slower than DDT in knocking down house-flies and at 0·005 p.p.m. killed only 10 per cent. of *Anopheles* larvae in 48 hours, as compared with 95 per cent. for DDT. It is stated by German workers that parachlorphenylchlormethylsulphone is five times as effective as DDT against *Pediculus* and bed-bugs [*Cimex lectularius*, L.], that phenylchlormethylsulphone is more effective against *Cimex* and less against *Pediculus*, that both are ineffective against *M. domestica*, and that trichlorethylene is the best solvent for them. In the United States, the first compound was less effective than DDT against *Pediculus*, but no louse eggs hatched when exposed to solutions containing 0·1 per cent.

of it. The second also possessed ovicidal properties, and both compounds are effective against *Pediculus* for long periods.

Deonier (C. C.), Jones (H. A.) & Incho (H. H.). **Organic Compounds effective against Larvae of *Anopheles quadrimaculatus*—Laboratory Tests.**—*J. econ. Ent.* **39** no. 4 pp. 459–462, 4 refs. Menasha, Wis., 1946.

Of 6,000 organic compounds tested in Florida in acetone-water suspensions to determine their toxicity to fourth-instar larvae of *Anopheles quadrimaculatus*, Say, only 175 caused mortalities of 50 per cent. or over in 48 hours at one part per million. A list is given of 145 of these (omitting compounds related to DDT with a few exceptions). The mortalities caused at various concentrations in 24 and 48 hours by 22 compounds that killed 50 per cent. of the larvae or more at 0·1 p.p.m. are shown in a table. Ignoring DDT and related compounds, the authors conclude that 1-trichlormethyl-2,2′-methylene bis(4,6-dichlorphenyl) diester of acetic acid, and benzene hexachloride and synthetic 3956 [a chlorinated camphene that has the approximate empirical formula $C_{10}H_{10}Cl_8$ and to which the name Toxaphene has been applied] are superior to the other compounds in their toxicity to Anopheline larvae. The γ isomer of benzene hexachloride was also tested and found to be more highly toxic than the crude product, which contains only 10–12 per cent. γ isomer.

Madden (A. H.), Lindquist (A. W.) & Knipling (E. F.). **DDT applied from the Ground for Control of Mosquitoes.**—*J. econ. Ent.* **39** no. 4 pp. 463–467, 3 refs. Menasha, Wis., 1946.

Investigations were carried out in Florida during the summer of 1945 to study factors that might affect the results obtained from the use of finely atomised sprays of DDT in oil applied from the ground against mosquitos in jungle. The principal species present were *Aëdes taeniorhynchus*, Wied., and *A. sollicitans*, Wlk., but there was also a moderate number of *Psorophora* spp. The effectiveness of the treatments was estimated from the numbers of mosquitos that settled on observers before and an hour after their application. Applied with a hand-operated paint sprayer, 20 per cent. DDT at 30 ml. per acre was significantly less effective (78 per cent. control) than it was when applied with a capillary-tube sprayer (94 per cent.). A 5 per cent. DDT solution applied with a pressure sprayer at 1,000 ml. per acre was significantly less effective (76 per cent.) than one applied with the paint sprayer at 250 ml. per acre (90 per cent.). With a constant dosage of 6 gm. DDT per acre, solutions of 5 and 10 per cent. DDT applied with a paint sprayer gave 86 per cent. control, but only 72 per cent. control was obtained with 20 per cent. DDT. It is concluded that concentrations of DDT greater than 10 per cent. are not practical when applied by a hand-operated paint sprayer of the type ordinarily used for this purpose. Treatment from the ground by competent men would be much less costly than spraying from aircraft, and the low dosages required would be less likely to affect beneficial insects and wildlife.

The time of day at which treatments were applied (dawn or mid-day) had no bearing on their effectiveness, apparently because meteorological factors remain fairly constant throughout the day under jungle conditions. A 5 per cent. solution of DDT applied at 125 ml. per acre gave controls of 83 and 90 per cent. with swathes 40 and 20 ft. wide, respectively, whereas conditions were reversed with a dosage of 250 ml. per acre. When a 20 per cent. solution was applied with the capillary-tube sprayer at 30 ml. per acre and a 5 per cent. solution with a paint sprayer at 125 ml., both over swathes 40 ft. wide, they effected controls of 69 and 91 per cent., respectively, in one hour. It is concluded that the small amount of spray needed with a capillary-tube sprayer is

inadequate to cover a 40-ft. swathe. Part of the effectiveness of DDT sprays may be attributed to the action of fuel oil or kerosene when one of these is used as the solvent.

In four comparative tests, 5 per cent. crude benzene hexachloride (containing about 12 per cent. γ isomer), with 15 per cent. cyclohexanone in fuel oil, and a 5 per cent. DDT solution, both applied with paint sprayers at 125 ml. per acre, gave average controls of 64 and 84 per cent., respectively. It is concluded that at the same dosage of DDT and γ isomer, the benzene hexachloride might be the more effective.

YATES (W. W.). **Time required for *Aëdes vexans* and *A. lateralis* Larvae to obtain a lethal Dose of several Larvicides.**—*J. econ. Ent.* **39** no. 4 pp. 468–471, 5 refs. Menasha, Wis., 1946.

As most mosquito larvicides cease to be efficient as soon as they cease to maintain a surface film over the water, the rapidity of their action is of importance. In laboratory tests, complete or almost complete mortality among fourth-instar larvae of *Aëdes vexans*, Mg., and *A. lateralis*, Mg., resulted from exposure for two hours to standard pyrethrum emulsion [an emulsion of oil containing pyrethrum extract (*cf. R.A.E.*, B **23** 205)] at 2 U.S. gals. oil per acre or for three hours to diesel-oil emulsion at the same rate or unemulsified oil at 10 U.S. gals. The addition of 2 per cent. dinitro-o-cyclohexylphenol to the diesel oil in the emulsion shortened the time required for the larvae to obtain lethal amounts. Larvae exposed for one hour or two hours to a 5 per cent. dust of Paris green applied at 2 lb. per acre were nearly all dead in 24 hours and none recovered. Results with phenothiazine preparations at one part phenothiazine per million were erratic. The initial effect was stupefaction, but many of the larvae recovered when removed to fresh water. Results were better with a solution than with a suspension or an emulsion. DDT at 0·02 lb. per acre was slightly slower in action than were several of the common larvicides. Exposure for four hours to liquid preparations of DDT was needed to cause as high mortality as could be obtained by two hours' exposure to pyrethrum in oil emulsion and oil larvicides. It was necessary to expose larvae twice as long to dusts as to liquid preparations to obtain the same results, and when dusts were used a larger number of larvae obtained only enough poison to affect them temporarily. Considering the very small amount of DDT used, and the consequent wide spacing of particles on the surface of the water, the results obtained with exposure for only a few hours are considered remarkable.

CULPEPPER (G. H.). **Factors influencing the Rearing and Maintenance of a Laboratory Colony of the Body Louse.**—*J. econ. Ent.* **39** no. 4 pp. 472–474, 7 refs. Menasha, Wis., 1946.

The results are given of studies carried out at various temperatures and humidities, which indicated that the optimum conditions for rearing and maintaining a laboratory colony of *Pediculus humanus humanus*, L. (*P. h. corporis*, Deg.) [*cf. R.A.E.*, B **33** 161] are a temperature of 85°F. and a relative humidity of 60 per cent. Under these conditions and (in brackets) at 90° and 90 per cent. humidity, adult females lived for an average of 23·4 (12·6) days and laid an average of 105·7 (41·9) eggs at the rate of 4·5 (3·3) per day, and the maximum duration of adult life was 54 (28) days. In most tests, mortality began on about the fifth day and increased daily until all lice were dead. The optimum conditions of temperature and humidity were also suited to the development of the immature stages. About 95 per cent. of the eggs hatched, after 8–9 days, and 85–95 per cent. of the resulting lice became adults, in 9–11 days.

A laboratory colony of the lice can be maintained on only one feeding per day at 80°F. and 60 per cent. humidity, but two feedings per day are recommended to obtain large numbers of eggs. Other important factors affecting the successful maintenance of a colony are cleanliness and regularity of feeding.

WOLFENBARGER (D. O.). **Observations on the Airplane for Application of Sprays and Dusts.**—*J. econ. Ent.* **39** no. 4 pp. 503–505. Menasha, Wis., 1946.

The author discusses the use of aeroplanes for the application of insecticides and reports observations on the deposits of dusts and sprays obtained with them. The number of particles or droplets was greatest under the aeroplane and decreased towards the margin of the swathe covered. The width of this varied with the height of flight and wind velocity. When slides were exposed 3–14 inches above the ground below the line of flight and a spray applied from a machine flying at a height of 8–10 ft., the upper surfaces had more than nine times as many spray particles as the lower. Almost as many droplets were deposited on low as on high slides, but the proportion on the under surface was slightly greater for the higher ones, and both the total number of droplets and the proportion on the lower surface was higher on one day than on another.

GOODHUE (L. D.). **Aerosols and their Application.**—*J. econ. Ent.* **39** no. 4 pp. 506–509, 15 refs. Menasha, Wis., 1946.

This discussion of various methods of applying insecticides in aerosol form is chiefly based on the literature. It includes references to the production of aerosols by incomplete combustion of materials containing insecticides, by spraying an oil solution of insecticides on a hot surface to form a vapour that immediately condenses into a fog when cooled by contact with air [*R.A.E.*, B **28** 239], and by mechanical means, such as air-atomising nozzles and revolving disks, but deals chiefly with those generated by liquefied gases [*cf.* **31** 167] and thermally generated aerosols formed by heating a mixture of water and an oil solution of the insecticide until the water is converted into superheated steam, which breaks up the insecticide solution into aerosol-sized droplets when released through a nozzle [*cf.* **35** 128–129].

The particles in an aerosol range from 0·5 to 50 microns in diameter ; above this range the advantage of being airborne is lost. Particles smaller than 0·5 micron are of little insecticidal value because a lethal dose is collected too slowly by the insect. To achieve comparable results, an aerosol with one-micron particles requires an exposure 85 times as great as one with ten-micron particles. The most effective range for confined spaces is 10–20 microns. Increasing the velocity of a small particle increases its effectiveness because more kinetic energy helps it to pass through the streamline layer of air round the insect. Small slow-moving particles are not easily deposited. For outdoor use, the particle diameter of a drifting aerosol should be about ten microns in order to allow as much coverage as possible. The velocity imparted by the wind gives sufficient precipitation on the insect.

The use of liquefied gas aerosols against mosquitos and other insects in houses, and experiments with them against greenhouse and field-crop pests [*cf.* A **34** 239–244] are reviewed, and possible methods of reducing the cost of the small dispensers known as aerosol bombs are discussed. In thermal-generated aerosols, the range of particle size can be regulated by varying the viscosity of the oil or the temperature to which it is heated. A relatively non-volatile oil solvent for DDT should be used, or the aerosol particles will shrink too rapidly by evaporation during application. Thermal-generated aerosols are for large-scale use ; they are applied out of doors by drifting the cloud across the desired area under meteorological conditions that will hold it close to the ground.

Inversion conditions (a layer of colder air next to the ground) are the most favourable and usually occur during the periods near dawn and dusk. A wind movement of 1–4 miles per hour is desirable. Since the concentration of these aerosols is greatest nearest the generator and diminishes with distance, it is necessary to overdose the intervening area to obtain a high degree of control at a distance, and it is therefore more economical to treat in narrow strips than in wide ones. Adults and larvae of mosquitos have been controlled downwind from the point of generation for distances ranging from 1,200 ft. in heavily wooded areas to nearly a mile in open terrain [*cf.* also B **35** 69]. These aerosols are very toxic to horn flies [*Siphona irritans*, L.] on cattle [*cf.* B **35** 141], and filling a stable with the aerosol left enough residue to reduce the fly population satisfactorily for several weeks.

Jones (H. A.) & Fluno (H. J.). **DDT in Colloidal-type Suspensions.**—*J. econ. Ent.* **39** no. 4 pp. 536–537, 1 ref. Menasha, Wis., 1946.

To determine the practical upper limit of DDT concentration in colloidal suspensions [*cf. R.A.E.*, B **34** 126], comparisons were made of suspensions containing 1, 2 or 5 per cent. DDT, prepared from concentrates comprising DDT, surface-active agent and water-miscible solvent in the proportions of 10 : 10 : 80 or 15 : 15 : 70. The surface-active agents were Triton X-100 (polyethylene glycol alkyl aryl ether) or Nopco 1216 (sulphonated sperm oil) and the solvents were acetone or cellosolve (ethylene glycol monoethyl ether). With 5 per cent., separation of DDT occurred immediately. With 1 or 2 per cent. DDT, the suspensions were stable when Nopco 1216 was used with either solvent but only fairly so with Triton X-100. In March 1943, colloidal or nearly colloidal suspensions of DDT were prepared by adding to water a solution of DDT and Wetsit Concentrated (alkylated aromatic sulphonate) in cellosolve. Later, with concentrates comprising 10 per cent. DDT, 10 per cent. surface-active agent and 80 per cent. cellosolve, comparisons were made at 10 parts DDT per million of the physical stability of aqueous suspensions using different surface-active agents. Separation began immediately when no surface-active agent was used, in 24 hours with Triton B-1956 (polyglyceride of a glyptal resin), in about a week with Vatsol OT (dioctyl sodium sulphosuccinate) and in 10–14 days with Wetsit Concentrated. There was no evidence of separation after several weeks with Nopco 1216 and Triton X-100.

In subsequent tests of several water-miscible solvents with the same surface-active agents, in which concentrates were added to water to give suspensions containing 0·5 per cent. DDT, cellosolve gave stable suspensions with the several surface-active agents used, and acetone, dioxane and butyl carbitol (diethylene glycol monobutyl ether) gave stable suspensions in some cases. Colloidal-type suspensions, especially those obtained with the concentrate containing Nopco 1216 and cellosolve, were found to be highly effective as mosquito larvicides in extensive tests, but at the concentrations necessary to give long-lasting results, they killed fish and other aquatic life. They appeared particularly suitable for the control of larvae in abandoned cisterns, fire barrels and similar static water in which other life was not important and effectiveness for long periods was desired. They also gave good results when tested as sprays to leave a toxic residue against mosquitos and flies.

Thompson (G. A.). **Effect of DDT residual Deposits on Scorpions.**—*J. econ. Ent.* **39** no. 4 p. 537. Menasha, Wis., 1946.

As it appeared that deposits from sprays of 5 per cent. DDT in kerosene were killing scorpions in houses in Jamaica, eight individuals, ranging in length from 2 to more than 4 ins., were caught and placed in contact with a freshly sprayed surface for several minutes and then confined in clean cages. All died within

12 hours. During the first two weeks of August 1945, military quarters were sprayed with 5 per cent. DDT to reduce infestation of various insects by residual action. They were closed for about a month and when the last were opened during the third week in September, ten dead scorpions were found on the floor within 6-12 ins. of the walls. They may have come in contact with the spray before it dried. W. H. W. Komp observed DDT to have similar effects on scorpions in British Guiana.

RANDOLPH (N. M.) & EADS (R. B.). **Gross Infestations of the domestic Rat with Ectoparasites.**—*J. econ. Ent.* **39** no. 4 pp. 538–539, 1 ref. Menasha, Wis., 1946.

The ectoparasites of a large number of rats taken from three urban areas in Lavaca County, Texas, included only a few scattered individuals of *Echidnophaga gallinacea*, Westw., but the rats trapped in buildings close to hen houses in rural areas frequently harboured large numbers of this flea. One individual of *Mus* (*Rattus*) *rattus alexandrinus*, trapped alive on a farm in 1946 was found to be harbouring 335 adults of *E. gallinacea*, 1,200 adults and later-instar nymphs of *Polyplax spinulosa*, Burm., about as many early-instar nymphs, and three mites (*Laelaps hawaiiensis*, Ewing). Two rats of the same species trapped alive on another farm harboured, respectively, 330 and 100 individuals of *E. gallinacea*, 22 and 0 of *Leptopsylla segnis*, Schönh., and 17 and 3 of *P. spinulosa*. About half the fleas, mainly females, were firmly attached about the nose and head. Some were still attached 12 hours after the host had been killed. The other half were running free over the host or readily detached themselves when disturbed. The lice were also found in large numbers about the head and shoulders, though most of the eggs were fastened to the long hairs of the back near the tail. The lice showed little inclination to leave the dead host, and it is doubted whether they survive the death of a host by transferring to another. Both *E. gallinacea* and *P. spinulosa* have been found naturally infected with the rickettsia of murine typhus by the laboratory of the Texas State Department of Health.

ROBERTS (R.). **Benzene Hexachloride for Animal Parasites.**—*J. econ. Ent.* **39** no. 4 p. 539. Menasha, Wis., 1946.

About an hour after some two or three teaspoonfuls of a dust containing 5 per cent. crude benzene hexachloride had been rubbed into the hair of a medium-sized, short-haired dog heavily infested with *Ctenocephalides canis*, Curt., 54 paralysed fleas were collected from the floor where the dog had rested and the path by which it left. No fleas were found on the dog after four hours, but some were taken from it three and four days later, though an odour of benzene hexachloride persisted. When a second dog was similarly treated and held over a sheet, nearly a teaspoonful of fleas was removed from the sheet. None recovered. Neither dog showed any ill effects from the treatment. Of four individuals of *Amblyomma americanum*, L., attached near the ears of a dog and treated with a pinch of the dust, three unengorged ones were paralysed within 30 minutes, and the fourth, a partly engorged female, continued active for about two hours. All four ticks were killed, though they retained some reflexes for 12 hours after treatment and removal from the dog, and similar treatment killed another group of four ticks and one large scorpion.

FURMAN (D. P.). **DDT used in Control of Latrine Flies.**—*J. econ. Ent.* **39** no. 4 pp. 541–542, 1 graph. Menasha, Wis., 1946.

DDT was tested at an army base in New Guinea against larvae and adults of *Chrysomyia megacephala*, F., which was breeding in human excreta. The

experiment was carried out on a series of five well-established pit latrines situated within 300 yards of a central point and separated by about a quarter of a mile from any other latrines. The pits were supplied with standard eight-seat boxes that appeared reasonably fly-proof. However, flies were breeding in the latrines in moderate to large numbers, presumably because the seats were occasionally left open. Before the experiment, waste paper and diesel oil or kerosene were burned in the latrines twice a week, and during the experiment this was done in the control latrine. During the three days immediately preceding the experiment, the numbers of flies trapped on emergence from the latrines were 1,270, 1,100, 653, 215 and 212, respectively. The third latrine was chosen as the control. A coarse-droplet spray of 5 per cent. DDT in kerosene was applied to the others with a two-quart decontamination sprayer. The first application was made at one U.S. quart per 250 sq. ft. of wall space. The spray was applied to the interior of the pit and contents, the interior and exterior of the box, the inside walls of the screen, and the ground inside the screen boundary. The contents of each pit were thereafter sprayed daily with one U.S. pint spray for two weeks. The control effected over this period ranged from 91·4 to 99·94 per cent. As the number of flies alive in the traps at the time of collection included an indefinite number that had only recently been exposed and trapped and would soon have died, actual control was somewhat better than this. A test made to investigate whether flies coming into contact with DDT in the latrine might deposit enough in the trap to affect unexposed flies gave no indication that this was so. Using total numbers of flies trapped per day as the criterion, the effectiveness of the DDT as a larvicide varied from 45 to 96·3 per cent. during the 14 days of daily treatment, but some of this apparent control of larvae was undoubtedly control of newly emerged adults. During the week after cessation of pit spraying on the 14th day, the numbers of flies emerging increased markedly, but there was not a corresponding increase in the number of flies surviving, since the average for the test latrines on the 21st day was only 1·8 per cent. of the 16-day average for the control latrine.

Linduska (J. P.) & Cochran (J. H.). **A Laboratory Method of Flea Culture.**—*J. econ. Ent.* **39** no. 4 pp. 544–545, 1 ref. Menasha, Wis., 1946.

A brief description is given of an easy method by which 3,000–4,000 fleas (*Ctenocephalides felis*, Bch., and *C. canis*, Curt.) were reared each week for wide-scale testing of repellents and poisons, 5–8 dogs being used to maintain this production level. After the dogs had been freed from other fleas and infested with the species required, they were kept in kennels with access to individual runways by day and confined in elevated screen cages with hardware cloth floors at night. Unattached flea eggs that were dislodged from the animals as a result of frequent scratching and shaking were caught on a heavy cloth fastened beneath the floor of the cage, recovered twice weekly and placed in lots of about 500 in battery jars with a capacity of about one U.S. gal. and containing a layer of dry sand one inch thick. About one teaspoonful of dried, powdered blood albumin was included as food for the larvae, and a second lot of food was added about 3–4 days after hatching. No food was provided for the adults, which were used for test purposes when 5–8 days old. Excessive humidity appeared to reduce percentage hatch.

Parish (H. E.) & Rude (C. A.). **DDT for Control of the Biting Sheep Louse.**—*J. econ. Ent.* **39** no. 4 p. 546. Menasha, Wis., 1946.

Damalinia (*Trichodectes*) *ovis*, L., causes intense irritation to sheep and injures the wool by weakening the fibres. Infested animals generally lose wool and weight. Dips containing 0·2 per cent. DDT were tested for its control in 1945. The stock solution for them (Stock 1235) was prepared by shaking

together one part by weight technical DDT and five parts water-miscible pine oil in a tight container, and it was diluted at the rate of 10 pints per 100 gals. water for the dip. As it does not form a satisfactory emulsion in alkaline water, a little should first be tested in the water to find if it mixes properly. Examination of 200 yearling sheep in full fleece that had been dipped when heavily infested revealed no live lice over a period of about three months. In a similar test in which 50 sheep in full fleece with an equally heavy infestation were dipped on 14th February, no live lice were found when the sheep were examined, and no harmful effects on animals or wool were observed. In a field test, 1,519 sheep and lambs were dipped during the first half of May, and no live lice had been found on them by the end of July.

WEBB (J. E.). **A spraying Apparatus and testing Chamber for investigating the residual Action of insecticidal Deposits.**—*Bull. ent. Res.* **38** pt. 2 pp. 209–232, 1 pl., 9 figs., 7 refs. London, 1947.

The following is substantially the author's summary. The construction of a spraying tower for obtaining even deposits of insecticide of known weight is given, and the method of adjustment of this apparatus and procedure adopted during spraying are described. To determine the weight of deposit obtained with different liquids and conditions of spraying, deposits of dye solution were collected on test-papers at different positions on the area sprayed, the dye was dissolved in 50 cc. of solvent and its concentration in this solution was measured by means of the Spekker Photo-electric Absorptiometer. By this method, estimations of the weight of dye deposited on each test-paper were made to 0·01 mg. with great rapidity. The standard deviation of the mean weight of deposit per test-paper for oil (petroleum distillate) and aqueous dye solutions, both from one test to another and between different positions on the area sprayed in any one test, fell between $\pm 0{\cdot}8$ and $\pm 3{\cdot}0$ per cent. of the mean under the most favourable conditions for spraying.

From studies of the effect of varying the factors governing weight of deposit, it was concluded first that when the surface to be sprayed is removed from the tower before the mist has completely settled and the time of exposure to the mist is constant, the weight of deposit varies directly with the degree of atomisation of the liquid sprayed, the deposit becoming lighter as the droplet size decreases ; and secondly, that the droplet size of the mist varies directly with the surface tension of the liquid sprayed and inversely with the energy (spraying pressure $\times$ spraying time) expended in atomising a given volume. Thus any factor that alters the surface tension of the liquid, the spraying pressure or the spraying time will alter the droplet size of the mist and the weight of deposit. When the mist has settled completely before the sprayed surface is removed, small variations in droplet size of mist appear to have no effect on weight of deposit. With the oil spray, the energy expended in atomising 5 cc. was progressively increased until a point was reached when the weight of deposit remained almost constant even when the energy was more than doubled. It is suggested that at this point no further reduction of droplet size is possible under the conditions of spraying. Small variations in spraying time or pressure should have no effect on the weight of deposit where droplet size of the mist is at a minimum.

An important factor governing the rate of evaporation of the spray droplets and hence the weight of deposit is the degree of saturation of the atmosphere within the tower with vapour of the liquid sprayed. This factor was controlled by spraying enough priming doses of liquid to bring the vapour pressure to near saturation point and by adopting a standard interspraying time so that the amount of vapour lost to the outside atmosphere between consecutive sprayings was always the same. In this way, the same partial pressure of vapour of the liquid at the commencement of each spraying was assured. At 20°C. [68°F.],

one priming dose was necessary for the oil spray and five doses for the aqueous spray. With the oil spray, the weight of deposit was less at 30°C. [86°F.] than at 20°C., but with the aqueous spray there was no significant difference. A rise in temperature would be expected to cause a reduction in the droplet size of the mist by decreasing the surface tension and viscosity of the liquids sprayed. This may be proportionately greater in the case of the oil spray than the aqueous spray. Even if this is not so, as the mist from the aqueous dye solution sprayed at 20°C., 25 lb./sq. in. spraying pressure and minimum spraying time settled within the five minutes for which test-papers were exposed, unlike that from the petroleum distillate dye solution, further reduction in size of the aqueous spray droplets can take place before some of them remain suspended for longer than five minutes and cause a fall in weight of deposit. Thus it would be expected that a rise in temperature would reduce the weight of the deposit from oil more than from aqueous sprays. It is, therefore, important to control temperature where oil sprays are used.

A reduction in the spraying pressure from 25 to 22·5 and 20 lb./sq. in. increased the minimum spraying time for 5 cc. of liquid to a different degree for the oil and aqueous sprays. With the former spray, the weight of deposit varied inversely with the energy expended in atomisation, and the energy used increased and the weight of deposit fell with decreasing spraying pressure. With the aqueous spray, the increase in energy with decreasing spraying pressure was very much less and no fall in weight of deposit was observed ; this is evidently because at 20 lb./sq. in. the aqueous droplets still settled within five minutes. Thus, for accurate replication of deposits from oil sprays, the spraying pressure should be rigidly controlled, but this is not so important for aqueous sprays.

Whereas at 20°C., 25 lb./sq. in. and minimum spraying time, the aqueous mist settled completely within four minutes, the oil mist was still partly in suspension after six minutes. Thus with a standard exposure of five minutes, there is a margin for reduction in the droplet size of the aqueous mist without loss in weight of deposit, which is not present in the oil mist. The weight of deposit from an oil mist will therefore be sensitive to any factor influencing droplet size.

When 1 to 8 cc. of liquid were sprayed at 20°C. and 25 lb./sq. in. and in minimum spraying times, the weights of deposit were proportional to the energy expended during spraying, but neither deposit nor spraying time was proportional to the volume of liquid sprayed. Furthermore, when a volume greater than 5 cc. was sprayed, the increase in deposit with spraying time fell by a constant amount. This is attributed to partial displacement of spray-laden air by the air stream from the atomiser that takes place after 4–5 cc., the amount required to fill the tower with mist, has been sprayed. The disparity between volume of liquid on the one hand and spraying time and weight of deposit on the other was due to the gravity feed of the atomiser in which the " head of liquid " standing in the reservoir was not proportional to the volume. This difficulty could be overcome by introducing a suction feed. Throughout these series, a heavier deposit was obtained from the aqueous than from the oil spray. This may have been due to a difference in the amount of spray evaporated. It is more probable, however, that given the same amount of evaporation from droplets of both liquids, a higher proportion of the water droplets still remained sufficiently heavy to settle and deposit the non-volatile dye within five minutes of spraying than the oil droplets, which initially are relatively small.

A restriction of the rate of flow of liquid through the atomiser, by closing the needle-valve and reducing the effective aperture of the fluid jet, prolonged the time taken to spray a given volume of liquid and thus increased the amount of energy available for atomisation. This reduced the droplet size of the mist and the weight of deposit. With the oil spray, the weight of deposit fell in inverse proportion to the energy expended until a spraying time of about 30 seconds was reached and then remained practically constant although the energy

available was more than doubled. It seems, therefore, that there is a limiting droplet size under the conditions of the spraying and that this was reached at 30 seconds spraying time. With the aqueous spray, the weight of deposit remained constant as the energy expended increased, until the droplets became sufficiently small for some of them to remain in suspension after the test-papers were withdrawn from the tower, whereupon the weight of deposit began to fall, though more slowly than that from the oil spray, in inverse proportion to the quantity of energy used. No limiting value for droplet size was reached for the aqueous spray. The rates of fall in weight of the deposits from the two sprays, *i.e.*, the energy needed in each case to produce droplets of given size, were in the same ratio as the surface tensions of the two liquids.

It was concluded that with oil sprays delivered at 20°C., 25 lb./sq. in. spraying pressure and minimum spraying time, it is necessary to exercise close control over these variables and over all details of spraying procedure if accuracy of replication of deposits is to be achieved. It may be possible, however, to relax these precautions if the sprays are delivered at spraying times above 30 seconds, *i.e.*, with the needle-valve partially closed, when droplet size of the mist is at a minimum. With aqueous sprays at 20°C., 25 lb./sq. in. spraying pressure and minimum spraying time, small variations in spraying conditions do not seem to affect the accuracy of replication or equality of distribution of the deposits.

The spraying tower described was designed to coat panels 20 cm. square with an even deposit of insecticidal material of known weight. These panels can then be built up into a cubical chamber for testing residual deposits of insecticides against such insects as house-flies [*Musca domestica*, L.], mosquitos, cockroaches or bed-bugs [*Cimex*]. The construction of this chamber and its method of use are described.

EDNEY (E. B.). **Laboratory Studies on the Bionomics of the Rat Fleas, *Xenopsylla brasiliensis*, Baker, and *X. cheopis*, Roths. II. Water Relations during the Cocoon Period.**—*Bull. ent. Res.* **38** pt. 2 pp. 263–280, 2 figs., 25 refs. London, 1947.

The following is based on the author's introduction and summary. In the previous paper of this series, it was shown that the length of life of unfed adult fleas bears a linear relationship to the saturation deficit of the air to which the cocoon stages have been exposed [*R.A.E.*, B **33** 76], and it was suggested that, as water appears to be conserved by pupae [**21** 199], it must be lost in relation to the saturation deficit of the air between cocoon formation and pupation and that emerging adults have a reserve of water depending on the saturation deficit experienced during this critical period. An account is given of experiments carried out on *Xenopsylla brasiliensis*, Baker, with a view to confirming or disproving the suggestion. They confirmed that length of adult life varies with humidity during the period spent in the cocoon but showed the cause to be loss of water during the pupal and not the prepupal period. Prepupae gained weight by the absorption of water vapour from the air if kept at 24°C. [75·2°F.] and any relative humidity from 50 to 90 per cent., but dried rapidly and failed to pupate if kept at a relative humidity below 45 per cent. During the prepupal period, which lasts about three and a half days from cocoon spinning to pupation at 24°C., the dry weight decreased by about 2 per cent. of the original total weight and the total weight increased by 4–29 per cent. with a mean of 14 per cent. The amount of water absorbed was independent of relative humidity within the range 50–90 per cent., and was approximately equal to the increase in total weight. The critical relative humidity, below which the insects die and above which they absorb water, was shown to be substantially the same (45–50 per cent. relative humidity) at 12, 24 and 35°C. [53·6, 75·2 and 95°F.]. Water was lost throughout the pupal period, the rate of loss increasing with decreasing humidity, though the effect of humidity was not very great. Adults

emerging from pupae kept at higher humidities weighed more, had higher percentage water contents and lived longer without food than those emerging from pupae kept at lower humidities. The results are discussed in the light of previous work, and suggestions as to the mechanism of the process of absorption of water are made.

MacLeod (J.). **The Climatology of Blowfly Myiasis. I. Weather and Oviposition.**—*Bull. ent. Res.* **38** pt. 2 pp. 285–303, 3 figs. London, 1947.

The following is substantially the author's summary. The relationship of oviposition by blowflies to weather, with a standard stimulus of 4 per cent. ammonium carbonate [*cf. R.A.E.*, B **25** 52–53], was tested in Hertfordshire in the summer and autumn of 1942 by making 134 exposures of a group of three lambs for one hour. Of the 190 egg clusters obtained, 169 were identified, and all were *Lucilia sericata*, Mg., except one which was *L. caesar*, L. There was a fairly close correlation (0·586) between oviposition and air-temperature. When the possible effect of other factors was eliminated, the correlation was little affected, showing that temperature was in itself responsible for the variation in oviposition. The lower critical limit of temperature was about 56–58°F. An apparent correlation between solar radiation and oviposition was found to be spurious, being due to related air-moisture changes. At temperatures near the lower critical limit, insolation did not increase the oviposition rate or lower its temperature threshold. Humidity had an apparent inverse correlation with oviposition, but this also was an indirect effect, due to related temperature changes. Humidity showed a closer correlation when expressed as saturation deficiency than as relative humidity. Evaporation rate from a white atmometer sphere had only a low correlation with oviposition. It is shown that the partial correlations of both saturation deficit and insolation, with temperature effects eliminated, are insignificant. The multiple correlation coefficient for temperature, humidity and insolation is practically identical with that for temperature. Independent variations of insolation (variations not simultaneous with related temperature changes) had a significant effect on oviposition. For a given temperature, a high intensity of insolation was less favourable than a low intensity, and this appeared to be a true effect of insolation not due to associated humidity changes. Independent variations of humidity had a suggestive but statistically insignificant effect, humidity tending to be inversely related to oviposition. The regression of log oviposition on temperature, within the limits of this experiment, *i.e.*, at temperatures up to 72°F., was linear. The slope was not significantly affected by the insolation and humidity factors, the total coefficient being 0·0419, and the partial coefficient 0·0428. These coefficients are the increase of the log number of egg clusters (plus one) for an increase of 1°F., *i.e.*, the oviposition rate increased in geometric progression for unit increase of temperature, the value (N+1) for egg clusters doubling itself for 7° increase.

Parkin (E. A.) & Green (A. A.). **DDT residual Films. I. The Persistence and Toxicity of Deposits from Kerosene Solutions on Wall-board.**—*Bull. ent. Res.* **38** pt. 2 pp. 311–325, 4 figs., 7 refs. London, 1947.

An account is given of the methods used and results obtained in experiments to test the persistence and toxicity of deposits of DDT from kerosene solutions by exposing flies (*Musca domestica*, L.) to deposits on wall-board. The following is mainly based on the authors' summary of the results; a brief account of some of those obtained in the first part of the work has already been noticed [*R.A.E.*, B **34** 122]. Initial toxicity, measured by speed of knock-down, increased as the deposit of DDT per unit area from a solution of fixed concentration increased. It also rose as the concentration of DDT in the solution increased,

when the amount of DDT applied was kept constant. It was shown that, in practice, DDT should be applied to absorbent materials at as high a concentration as possible consistent with reasonable coverage (normally 5 per cent. in kerosene unless an auxiliary solvent is used) to avoid much of the DDT being carried by the solvent into the substratum, where it is no longer available for contact with the insects. With wall-board, there was found to be a critical value for the product of concentration and deposit of DDT above which any mechanical stimulus, including movement of flies on the treated surface, caused the DDT present in supersaturated solution to crystallise, with a consequent marked increase in the toxicity of the film. Under some circumstances, removal of the carpet of crystals was followed by its partial regeneration. Long crystals formed by brushing were as toxic as more numerous smaller ones formed by the movement of flies. If the product of the concentration and deposit fell below the critical value, the residual film was at no time very effective and soon lost its initial toxicity.

A more extensive experiment in which squares of treated wall-board were exposed four days and various numbers of weeks from four to 78 after treatment supported the conclusions of the earlier ones and indicated that the product of concentration (percentage w/v DDT in kerosene) and deposit (mg. DDT per sq. ft.) must exceed about 150 for a marked increase in toxicity to flies due to secondary crystallisation to be observed. Films that showed no increase in toxicity after the first exposure to flies showed no increase after subsequent exposures. The persistence of the toxicity of the films over an exposure period of 18 months was closely bound up with the crystallisation of the deposits and their powers of regeneration during intermittent exposure to flies.

HOCKING (K. S.). **The Use of Bamboo Pots to indicate *Aëdes* Prevalence.**—*Bull. ent. Res.* **38** pt. 2 pp. 327–333, 2 refs. London, 1947.

The prevalence of *Aëdes* mosquitos in certain rural airfields in Africa has been assessed by filling bamboo pots about one foot long and 3 ins. in internal diameter with water, exposing them at ground level or 3 or 6 ft. from the ground and recording the larvae found in them after five days. Smaller pots proved unsatisfactory, and new pots were unsatisfactory for the first 2–3 weeks. The method is based on those of Dunn [*R.A.E.*, B **16** 27] and Harris [**31** 22], and though the tests of it are incomplete, they indicate that it may give a reliable index in rural areas and also provide useful information not given by the house larval index in urban areas. Results are given of tests made in 1943–45 in four areas in Kenya, Tanganyika and Madagascar, and an attempt is made to interpret these results in the light of the theoretical meanings of the pot index and the house larval index. The pot index is the percentage of bamboo pots containing *Aëdes* larvae at the end of the period of exposure. With a given number of egg-laying females, it varies according to the number of breeding places available to them. Together with the house larval index, it can be used to assess the fluctuations in an *Aëdes* population and hence the efficiency of control measures. The house larval index is the percentage of houses in which *Aëdes* larvae are found and is a measure of the adult population only if it is a completely accurate record. In practice, its accuracy is often low because of the inaccessibility of some breeding places, the difficulty of making thorough searches or lack of diligence in the search. The pot index is not subject to these practical limitations and if the pots are sufficiently numerous and well distributed, little supervision is necessary to secure an accurate record. As it depends on the proportion of adults to possible breeding places, it may be difficult to interpret with a naturally fluctuating *Aëdes* population but gives a direct measure of the adult population in a well controlled area, where the number of possible breeding places is very low and fairly constant. The main practical value of the pot

index would therefore seem to be its use with the house larval index for a comprehensive assessment of fluctuations in population and control measures, and alone to give a sensitive index of adult population in a well controlled area and to provide information about prevalence in a rural area where a house larval index cannot be obtained.

BARLOW (F.) & HADAWAY (A. B.). **Preliminary Notes on the Loss of DDT and Gammexane by Absorption.**—*Bull. ent. Res.* **38** pt. 2 pp. 335–346. London, 1947.

A short account is given of preliminary observations on the loss of DDT and the γ isomer of benzene hexachloride (gammexane) by absorption into sprayed surfaces, made in Uganda during field and laboratory investigations on their use against *Glossina palpalis*, R.-D., on the shores and islands of Lake Victoria and against mosquitos in native huts. The toxicity of the deposits to *Glossina* was tested by exposing the flies to them (for 20 seconds unless otherwise stated) and recording mortality after 24 hours.

The plants chosen for sampling in nature were *Alchornea cordata*, which has smooth, hard leaves, and *Triumfetta macrophylla*, the leaves of which are soft and very hairy. Both are common in the lake-shore bush inhabited by *Glossina*. A few estimations of surface deposits were also made on the smooth, hard leaves of avocado and the soft hairy leaves of a species of *Hibiscus*. The methods of making the chemical estimations is described; it was based on hydrolysable chlorine. When known dosages of DDT (pure p,p′) were applied as a solution in benzene to leaves of avocado and *Hibiscus*, 80–90 per cent. of the DDT was recovered from the surface of the leaves 4–6 days later, the smallness of the loss by absorption being probably due to the high volatility of the solvent. Deposits were lost much more rapidly from *Hibiscus* than avocado. About 20 per cent. of the DDT recovered from leaves treated in the field with 5 per cent. DDT (83 per cent. p,p′) in equal parts of kerosene and cottonseed oil was inside the leaves. No correlation was apparent between estimated surface deposit and percentage kill of *Glossina*, which varied from 5 to 67 after exposure for 10 seconds. In a later trial, in which vegetation was sprayed to give as uniform a deposit of DDT as possible, initial loss by absorption was rapid and great, the amount inside the leaves in one case reaching 50 per cent. of the total recovered, and was followed by a gradual loss from both outside and inside. The leaves of *Triumfetta* retained the surface deposit longer than those of *Alchornea*, but it was much less toxic than was expected (causing only 45–5 per cent. kill of *Glossina* 1–35 days after spraying, as against 100–10 per cent. on *Alchornea*). This may have been because the hairiness of the leaves prevented contact between the deposit and the insect. When various preparations of DDT and gammexane were applied, there was again as much as 50 per cent. loss of both through absorption into the leaves when simple solutions were used. Much less DDT was recovered from the inside of leaves treated with an emulsified solution and only a very small proportion of the gammexane applied as a water suspension of a dispersible powder. Gammexane disappeared rapidly from both the inside and outside of leaves in all cases.

In a preliminary laboratory test of application to mud and thatch, the materials that usually compose African huts, surfaces were treated with a 5 per cent. solution of DDT (83 per cent. p,p′) in equal parts of power kerosene and cottonseed oil. There was rapid absorption in mud, and about 40 per cent. of the application was relatively deeply absorbed. Deposits one day old on mud, thatch and glass killed 15, 100 and 100 per cent. of *G. palpalis*, and deposits 14 days old killed 0, 5 and 90. It is not known whether the loss of available insecticide on thatch is due to absorption by the dried grass stems as

well as penetration between them. Mud blocks treated with emulsions containing DDT or gammexane dried quickly, showing little evidence of deposit, but those treated with suspensions of dispersible powders in water showed a good surface deposit of white particles. The kills of *Glossina* given by the emulsions were poor, never more than 10 per cent., whereas a suspension containing 1 per cent. γ isomer of benzene hexachloride gave 100 per cent. kill three days after application and one containing 1·25 per cent. DDT gave 26·7 per cent. on the 17th day. To compare the toxicities to *G. palpalis* of dispersible powders and simple oil solutions, mud blocks, thatch and glass were sprayed with a suspension containing 1 per cent. γ isomer, a suspension containing 1·25 per cent. DDT, and 10 and 5 per cent. solutions of DDT (83 per cent. p,p′) in power kerosene. The solutions gave poor kills of *G. palpalis* on mud, but kills on thatch were relatively good. Results with suspensions were as good on mud as on glass. In a large field trial against mosquitos, involving 2,300 huts, mud blocks were placed in sample native huts, each of which was sprayed with a different preparation. At various intervals, one block from each hut was brought into the laboratory for exposure of mosquitos to it and for chemical determination of the deposit. Dispersible DDT powder was absorbed to a much smaller degree than other preparations used. Dieseline solutions of DDT and gammexane were almost entirely absorbed. The addition of cottonseed oil to kerosene appeared to check absorption to a small extent. A gammexane dispersible powder was highly effective for 2–3 weeks, but then lost its toxicity.

Tests were also made of the deposit from 5 per cent. DDT in kerosene on limewashed blocks of cement and plaster, representing the interiors of European houses in the tropics, and on limewashed glass plates. Kills of *G. palpalis* exposed for 20 seconds on these surfaces were very low (0–5 per cent. on the blocks and usually less than 25 per cent. on the plates). Exposure to a crystalline compound obtained by extraction from the plates indicated that no change was occurring in the DDT applied to limewash, but that loss of toxicity was probably due to masking by absorption. Longer exposures (2 and 5 minutes) on the plates gave 60 and 80 per cent. kills. A control glass plate treated at the same time with DDT gave 100 per cent. kill after contact for 20 seconds. Kills of *Aëdes aegypti*, L., exposed to DDT on a limewashed plate for 5 and 10 minutes nine days after treatment and for 10 and 30 minutes 14 days after treatment were 20, 40, 33 and 60 per cent., respectively, whereas a control plate gave complete kills with exposures of 5 minutes after nine days and one minute after 14 days. Dispersible powders of DDT and gammexane sprayed on limewash appear to be more promising than solutions.

Further information on dispersible powders is given in an appendix. Neocid B.A.50, a powder containing 38 per cent. p,p′ DDT, mixed with water to give a 5 per cent. suspension of DDT, was applied to glass plates limewashed two weeks previously, and 20 adults of *G. palpalis* were exposed for 15 seconds two days and two weeks later. All were killed. When tsetses were similarly exposed to limewashed and control glass plates sprayed with a water suspension of N.210 spray powder (containing 14·3 per cent. p,p′ DDT) diluted to contain 2 per cent. DDT, the limewashed plates always gave over 85 per cent. kill, whereas the control plates never gave more than 15 per cent. The deposit from a suspension of N.210 powder on mud blocks was white, whereas the deposit on a non-absorbent glass plate was khaki. This suggested that the water soluble "adhesive" (sulphite lye) was absorbed into the mud, leaving an effective deposit on the surface, but that after evaporation of the water from the non-absorbent surface, the adhesive masked the effect of the DDT deposit. When a water suspension of N.210 powder was allowed to stand, the brown liquid decanted and a water suspension of the resulting white sediment sprayed on to a glass plate, it gave a kill of 75 per cent. of *G. palpalis* exposed for 15 seconds 24 hours later. The analysis of the lime used in the tests is given.

WHITNALL (A. B. M.) & BRADFORD (B.). **An arsenic-resistant Tick and its Control with Gammexane Dips.**—*Bull. ent. Res.* **38** pt. 2 pp. 353–372, 2 pls., 1 fig., 15 refs. London, 1947.

The history of investigations on the control of the apparently arsenic-resistant strain of *Boophilus decoloratus*, Koch, on cattle, in the East London area of Cape Province is reviewed [*cf. R.A.E.*, B **35** 35, 64]. It was thought at one time that reliable results could be obtained only by testing the ticks on their hosts, but as this procedure was very cumbersome, a technique for treating ticks in the laboratory was devised. Adult females were used, as males usually suffer high mortality soon after removal from the host. In the case of liquids, the method adopted was to immerse the ticks for five minutes, and then place them ventral surface down on cotton-wool that had been wrung out in the same liquid, and leave them to dry for one hour in a chamber with a fan running. After this, they were kept in tubes at 25°C. (77°F.) and 100 per cent. relative humidity. The treatment was designed to simulate natural conditions in which the ticks are immersed in a dip and then dry in the wind on the hairy coat of the host. The drying was important as ticks placed too wet in the tubes were unnaturally susceptible. The five minutes' immersion time was arbitrary, but varying the period from one to ten minutes made no difference to the ultimate results. In the case of dusts, females were placed in tubes containing the test material and the tubes were gently shaken and rotated. The ticks were then transferred to clean tubes. To test larvae, they were placed in tubes and the whole immersed in the liquid to be tested or strips of paper moistened with the insecticide were inserted into the tubes.

The technique has been put to exhaustive test, and some 15,000 adult females of *B. decoloratus* have been subjected to *in vitro* treatments with remarkably consistent results. Experiments are discussed that suggest that arsenic kills ticks by contact. By using the technique described on ticks from different localities, it was possible to prove the existence of an arsenic-resistant strain of *B. decoloratus* in South Africa. Toxicity to presumed resistant strains as indicated by oviposition and viability of egg batches, the criterion used throughout, increased with a rise in the concentration of arsenic, 0·16 per cent. As_2O_3 (the strength of the normal weekly dip) having little effect while 0·64 per cent. gave 65 per cent. control. The lowest concentration gave almost complete control of the non-resistant strain. Arsenic-resistance was found to vary from locality to locality. Discontinuing the regular dipping of cattle appeared to lower the resistance of the ticks in 8–10 months. It would seem that when the resistant strain has established itself on any farm, the continued dipping of cattle in arsenical washes causes an artificial selection of resistant ticks and thus aggravates the position. *In vitro* tests in which females were treated with solutions of sodium arsenite neutralised to pH 4–5 and containing 0·16, 0·32 and 0·64 per cent. As_2O_3 or solutions of arsenic pentoxide neutralised to pH 4–5 and containing As_2O_5 equivalent to these percentages of As_2O_3, indicated that As_2O_3 is more effective than As_2O_5 against the resistant tick.

Tests of arsenic and nicotine [*cf.* **35** 35] at various concentrations separately and combined showed that again the higher concentrations of arsenic were more effective against the female ticks whether alone or combined with nicotine. Nicotine alone had little or no effect and did not increase the effectiveness of the arsenic. This confirmed field observations on adult female arsenic-resistant ticks. It is presumed that the effectiveness of the combined dip when used weekly in the field must be due to susceptibility to it of some other stage, probably the larvae, a view supported by laboratory tests with larvae.

The effectiveness of benzene hexachloride against the arsenic-resistant tick [*cf.* **35** 64], which is attributed to its γ isomer (gammexane), was first ascertained in tests of a preparation of miscible oil containing 20 per cent. refined benzene hexachloride diluted to contain 0·004–4 per cent. benzene hexachloride,

equivalent to 0·0015 1·4545 per cent. gammexane. All these dilutions completely prevented either oviposition or hatching of eggs laid, while all treatments containing more than 0·0364 per cent. gammexane prevented any oviposition. When the mouthparts of the ticks were sealed, results were largely similar except at the three lowest concentrations ; with 0·0015 per cent. gammexane, all the females oviposited and 80 per cent. of the batches hatched. A characteristic flattening, grooving and curving of ticks treated with gammexane was noticeable for all dilutions ranging from 0·0029 to 1·4545 per cent. in both experiments. Death occurred gradually 9–64 days after treatment. Water suspensions prepared from a dispersible powder preparation containing 50 per cent. crude benzene hexachloride with Goulac (sulphite lye) diluted to contain 0·001–1 per cent. gammexane prevented either oviposition or hatching of any eggs laid at all dilutions, and concentrations of 0·034 per cent. gammexane and over prevented all oviposition. There appeared to be no relation between the concentration of the gammexane and the time elapsing before death. Ticks treated in water only often died before those treated with gammexane, but they all oviposited and all egg batches hatched. A dust containing 20 per cent. crude benzene hexachloride with gypsum diluted with kaolin to contain 0·1 2 per cent. gammexane completely prevented oviposition or hatching. There was no control when the concentration was only 0·01 or 0·02 per cent., but when it was 0·05 per cent., there was 60 per cent. control. The conclusion that suspensions and emulsions containing gammexane are 20 times as toxic to adult females of *B. decoloratus* as dusts was confirmed in a further experiment in which dusts of crude benzene hexachloride, gypsum and kaolin and crude benzene hexachloride and kaolin, containing 0·02, 0·05 and 0·1 per cent. gammexane, were compared. The mixture containing gypsum gave the better results, probably on account of better mixing. In May 1945, three head of cattle were dusted weekly with dust containing 0·1 per cent. gammexane. The dust did not harm the animals, but the control of ticks was not striking.

In an experiment to compare the toxicities of five substances to adult females, gammexane was outstanding, giving complete control at dilutions of 0·0029 per cent. or over, while treatment in 1 per cent. DDT resulted in only 60 per cent. control. Sodium arsenite gave complete control at 0·64 per cent. As_2O_3 and 40 per cent. control at 0·16 per cent. Rotenone and nicotine failed to give more than 20 per cent. control at any concentration tested. In a further comparative experiment, the toxicity of emulsions containing gammexane was again demonstrated, and the minimum effective gammexane content appeared to lie between 0·0029 and 0·0073 per cent. in an emulsion prepared from the miscible oil containing 20 per cent. benzene hexachloride and between 0·0007 and 0·0015 per cent. in an emulsion made by dissolving 10 gm. refined benzene hexachloride containing about 30 per cent. gammexane in 58 gm. methyl alcohol, shaking up with 132 gm. Turkey red oil and diluting with water. Anabasine sulphate at the concentrations used (0·1–0·8 per cent. anabasine) proved useless, and the strain was shown to be very resistant to arsenic. Trollope's remedy (a 0·16 per cent. As_2O_3 wash with the addition of 1 gal. disinfectant of the creosote type and 2 gals. dieseline per 400 gals.) gave 60 per cent. control, and 0·5 per cent. dieseline gave 90 per cent. None of the gammexane preparations tested was considered suitable for cattle dips, but progress is being made with formulations that can be used in dipping tanks.

Acree jr. (F.), Jacobson (M.) & Haller (H. L.). **The Structure of Affinin, the insecticidal Amide from** *Erigeron affinis* **D.C.**—*J. organic Chem.* **10** no. 5 pp. 449–451, 5 refs. Baltimore, Md., 1945.

The authors describe experiments on the structure of the insecticidal amide designated affinin [*cf. R.A.E.*, B **34** 191] obtained from the roots of the plant recorded as *Erigeron affinis* [but now considered to be *Heliopsis longipes*

(*cf* **36** 7)], from which they conclude that it is the pure compound N-isobutyl--2, 6, 8-decatrienoamide.

WOLFENBARGER (D. O.). **Dispersion of small Organisms. Distance Dispersion Rates of Bacteria, Spores, Seeds, Pollen, and Insects ; Incidence Rates of Diseases and Injuries.**—*Amer. Midl. Nat.* **35** no. 1 pp. 1–152, 181 graphs, 9 pp. refs. Notre Dame, Ind., 1946. Reprints obtainable at $1.00, post paid.

The distance to which organisms disperse is important in planning their control, and to provide quantitative information on the subject, the author analyses published data on the horizontal and vertical dispersion of small animate and inanimate objects. The results are shown on graphs relating the incidence of inanimate objects, plants (including fungi and bacteria), viruses and insects to the horizontal distance from the source, and of insects and micro-organisms (bacteria, fungi and pollen) to the height above it. Consideration of these indicates that dispersion may be initiated by internal factors, such as the reproductive impulse, hunger, periodicity of habit or gregariousness, or by external influences such as overcrowding, shortage of food, change of food conditions, quantity or quality of light, temperature and moisture conditions, wind, or the intervention of other organisms, and that the distances to which organisms disperse depend on the species, activity, generation or phase involved. A general discussion on horizontal and vertical dispersion includes notes on the direction of dispersion, migration (movements between localities in one or both of which breeding occurs), means and agents of dispersion, the effect on dispersion of density level at the source, and the relation of dispersion to the application of control measures. A few of the general problems involved in relating dispersion and incidence to distance are indicated.

ARCHETTI (I.). **Distribuzione e diffusione delle leishmaniosi nell'Africa Orientale Italiana.** [Distribution and Diffusion of the Forms of Leishmaniasis in Italian East Africa.]—*Riv. Biol. colon.* **3** fasc. 6 pp. 401–418, 1 map, 4 pp. refs. Rome, 1940.

This is a review of the literature on the occurrence of various forms of leishmaniasis in Somalia, Eritrea, Abyssinia and neighbouring territories. It is shown that visceral leishmaniasis definitely occurs in the Anglo-Egyptian Sudan, Kenya [*cf. R.A.E.*, B **32** 87], Somalia, and Arabia (Aden and Yemen), cutaneous leishmaniasis in the Sudan, Kenya, Abyssinia, Eritrea and Yemen, muco-cutaneous leishmaniasis in the Sudan [*cf.* **28** 201], Abyssinia, British Somaliland and Yemen, and leishmaniasis in dogs in Eritrea. It is concluded that visceral leishmaniasis is endemic in Somalia and Eritrea, that dogs are a reservoir in Eritrea, and that foci occur along the border with the Sudan. Notes are given on the occurrence of *Phlebotomus* in the Sudan, Aden, Somalia and Eritrea, together with a list of seven species that have been recorded from Abyssinia and are known or thought to feed on man [**27** 34, 234 ; **28** 80], and a map showing the distribution of *Phlebotomus* and of recorded cases of leishmaniasis in the whole of the area considered.

CORRADETTI (A.). **Le conoscenze sulla distribuzione delle specie anofeliche nell'Africa Orientale Italiana.** [Data on the Distribution of Anopheline Species in Italian East Africa.]—*Riv. Biol. colon.* **3** fasc. 6 pp. 419–429, 27 refs. Rome, 1940.

A list is given of 19 species of *Anopheles* that had been recorded from Abyssinia, Eritrea and Somalia up to the end of 1939, with locality records showing the authorities for them [*cf. R.A.E.*, B **26** 67 ; **28** 89, 116, 117], and notes on the identity of some of the specimens concerned.

Stella (E.). **Nuovi dati sugli Ixodidi dell'Africa Orientale Italiana.** [New Data on the Ticks of Italian East Africa.]—*Riv. Biol. colon.* **3** fasc. 6 pp. 431–435, 2 fldg. tables, 4 refs. Rome, 1940.

A revised list is given of 48 species and varieties of ticks that have been recorded from Abyssinia, Eritrea, Somalia or British or French Somaliland [*cf. R.A.E.*, B **26** 196], showing the districts in which they have been found, together with notes on their relative abundance and the diseases they are known to transmit to man or domestic animals.

Pereira (C.) & de Castro (M. P.). **Contribuição para o conhecimento da espécie tipo de *Macrocheles* Latr. (Acarina) : *M. muscaedomesticae* (Scopoli, 1772) emend.** [A Contribution to the Knowledge of the Type Species of *Macrocheles* Latr. (Acarina).]—*Arq. Inst. biol.* **16** pp. 153–186, 22 figs., 64 refs. São Paulo, 1945. (With a Summary in English.)

In the course of studies carried out in São Paulo, Brazil, on the ecology of *Musca domestica*, L., mites of several related species were observed feeding on the eggs in the dung in which the house-flies were breeding. These mites were reared in the laboratory from females fed on eggs of *M. domestica*, and one species was identified as *Macrocheles muscaedomesticae*, Scop. The author describes all its stages, discusses its nomenclature and gives a list of its synonyms which include *M. muscae*, Ewing [*cf. R.A.E.*, B **2** 6] and *Holostaspis badius*, Koch [**19** 216]. Observations on its bionomics showed that the females are carried on the bodies of house-flies ; after alighting, they were unable to oviposit until they had fed, when they laid one egg daily as long as food was available. The eggs hatched in 5–6 hours, and the larval (proteronymphal) stage, in which the mites did not feed, lasted the same length of time. The protonymphal and deutonymphal stages, in which they fed freely, each lasted one day ; the moults were effected without interruption of activity or feeding. The females lived longer and fed more than the males.

M. muscaedomesticae was found principally in horse dung ; adults were often observed on the surface, but the immature mites avoided the light. The diet of both nymphs and adults was eggs of *M. domestica*, of which they destroyed a great number, often leaving them half-devoured ; occasionally first-instar larvae were also attacked. There was no evidence of feeding on adult house-flies, the mites using them merely for transport and up to three occurring on a single fly. They were not observed either in nature or in the laboratory on beetles or other species of flies, but a list is given from the literature of Coleoptera and Diptera that have been stated to carry them.

Papers noticed by Title only.

Metcalf (R. L.). **The Physiology of the Salivary Glands of *Anopheles quadrimaculatus*.**—*J. nat. Malar. Soc.* **4** no. 3 pp. 271–278, 7 refs. Tallahassee, Fla., 1945.

Nájera Angulo (L.). **Descripción de un dispositivo nuevo para la cría de *Phlebotomus*.** [Description of a new Apparatus for breeding *Phlebotomus*.] —*Riv. Biol. colon.* **3** fasc. 6 pp. 445–456, 1 fig., 14 refs. Rome, 1940. (With a Summary in Italian.) [See *R.A.E.*, B **29** 187.]

Peterson (A.). **A Manual of entomological Equipment and Methods. Parts I and** [illustrations of] **II.**—5th edn., 11×8½ ins. [4+] 24 pp., pls. 1–124, [2] pp., pls. 125–138, [2] pp., pls. 139–160, 13 tables, xiv pp., multigraph. Ann Arbor, Mich., Edwards Bros., Inc., 1947. [See *R.A.E.*, A **36** 9.]

Muesebeck (C. F. W.). **Common Names of Insects** [and other Arthropods] **approved by the American Association of Economic Entomologists.**—*J. econ. Ent.* **39** no. 4 pp. 427–448. Menasha, Wis., 1946.

Soberón y Parra (G.). **Algo acerca de la transmisión del mal del pinto.** [On the Transmission of "Mal del Pinto."]—*Aliis Vivere* **3** no. 14, Mexico, D.F. Repr. in *Kuba* **2** no. 2 pp. 40–43, 35 refs. Havana, 1946.

The author reviews the literature on the transmission of carate, which is caused by *Spirochaeta* (*Treponema*) *caratea*, and his own experiments in Mexico indicating that the spirochaete could be transmitted by flies of the genus *Hippelates* [*R.A.E.*, B **33** 125]. He here states that experimental transmission [*cf. loc. cit.*] was obtained in only one case and that the species of *Hippelates* concerned was probably *H. pallipes*, Lw. The spirochaete was retained in *Musca domestica*, L., and regurgitated in vomit drops, as in *Hippelates*. It is not known whether the drops regurgitated by *Hippelates* or *Musca* after an infecting meal are infective when placed on lesions on healthy persons.

Steiner (G.). **Fallenversuche zur Kennzeichnung des Verhaltens von Schmeissfliegen gegenüber verschiedenen Merkmalen ihrer Umgebung.** [Bait-trap Tests to determine the Reaction of Blowflies to various Characteristics of their Environment.]—[2 +] 37 pp., 14 figs., multigraph. Darmstadt, Zool. Inst. Tech. Hochsch., 1945.

The following is based partly on the author's summary of this detailed account of laboratory tests in Germany on the reactions of blowflies to olfactory and visual stimuli. The flies used were inbred, sexually mature adults of *Phormia regina*, Mg., and the tests, which were conducted on similar lines to those already noticed [*R.A.E.*, B **35** 198], involved, in most cases, the use of the larger cages and bait-flasks containing a 0·3 per cent. solution of ethyl amine. It was found that whereas in the smaller cages males were more attracted to light than were females, in the larger ones the traps nearest the light attracted more females than males. When half the number of bait-traps in the smaller cages were painted black, the darker ones were far less attractive than the others, but the difference in their attractiveness was less marked for females than for males.

The optical reactions of the flies were further tested by means of disks of glossy photographic paper, chequered with alternate black and white squares, which were fitted horizontally round the necks of the flasks. When patterns composed of squares with sides of 2·5, 5, 10, 15 and 20 mm. were each offered, together with squares having sides half as long, the results were variable but appeared to indicate that the smaller squares were preferred to the larger ones as long as they were recognised as such, but when they were so small that they must have appeared to the flies as a grey blur, they were less attractive than larger ones. Of squares with sides of up to 40 mm., 10-mm. squares were the most attractive to females and 2·5-mm. squares the least so, whereas males preferred squares with sides of 15–40 mm. to the others, with little difference between them. A pattern of black and white squares with 10-mm. sides was more attractive than one of dark and light grey squares of the same size. In tests in which water was substituted for ethyl amine, black and white patterns were more attractive than grey ones when the sides of the squares were 7·5 mm. or more long and less so when the squares were smaller. In field tests in 1943, baits surrounded by black and white patterns were more attractive to *Calliphora* than those that were not.

The ratio of attractiveness of 0·3 per cent. ethyl amine was lower in these than in the previous tests [*cf.* **35** 199], and higher and lower concentrations were even less attractive than 0·3 per cent.; since similar results were obtained when a different strain of *Phormia* was used, it is thought that the high ratios obtained previously were due to mutations in the laboratory strain that subsequently died out. It was also found that odours that were originally strongly repellent became less so as the flies became accustomed to them.

(51) Wt. P5/3779 2/48 S.E.R. Ltd. Gp. 432 [B]

McCulloch (R. N.). **Jetting Sheep to control Blowfly Infestation. The Advantages of a systematic Programme. Details of Equipment and Operation.**—*Agric. Gaz. N.S.W.* **57** pt. 11 pp. 589–593 ; **58** pts. 1–2 pp. 39–44, 95–98, 22 figs. Sydney, 1946–47.

In this comprehensive account of jetting for the prevention of blowfly infestation of merino sheep, as developed in New South Wales, emphasis is laid on the superiority over repeated crutching or hand dressing for large properties of a systematic programme in which all ewes are jetted in the spring and autumn as soon as there is strike or threat of strike and again whenever necessary, except during lambing. This usually means crutching once and jetting four or five times in the year. In experiments on the system, jetting did not interfere with mating [*cf. R.A.E.*, B **26** 150], nor did it cause any harm when the ewes were jetted at lamb marking. Jetted flocks gave slightly higher returns in lambs and wool and lower death rates than flocks treated by hand dressing. Jetting alone does not give complete protection for lambing ewes of class C [**28** 103], whereas perfectly plain-breeched merinos and crossbreds probably require it only in exceptional seasons. Mules' operation [**32** 142] should therefore be performed before jetting is adopted, and local experience will then indicate whether its adoption is necessary.

The equipment for jetting forms the subject of the greater part of the paper. The relative merits of hand pumps and large and small power plants, of nozzles of various sizes and hoses of different qualities, and of jetting races of various types are discussed. Detailed specifications and plans are given for the construction of the Tononga type of single-sheep raised race [**28** 102], and recommendations for the use of single-sheep raised races are included.

Finally, the preparation as jetting mixtures of sodium-arsenite solution and calcium-arsenite suspension, which is the more effective and economical, is described [*cf.* **22** 17 ; **25** 50-52], and notes are given on the re-use of run-off fluid and personal protection [*cf.* **27** 265] and on the avoidance of injury to the sheep from the jetting fluid. Reference is made to the fact that benzene hexachloride has considerable promise as a larvicide [*cf.* **35** 165, 166] and may prove more effective for jetting than the arsenicals.

Piédrola Gil (G.). **Nuevos insecticidas y ahuyentadores : su estudio, importancia y técnicas de empleo.** [New Insecticides and Repellents : their Study, Importance and Modes of Use.]—247 pp., 35 figs., 6 graphs, many refs. Madrid, Inst. esp. Med. colon., 1947. Price 75 *ptas.*

This book, which was compiled from personal studies and from the world literature, deals chiefly with the properties and use of DDT and benzene hexachloride. Separate chapters are included on their chemistry and development ; their mode of action and its biochemical interpretations ; the symptoms produced in insects and mammals and methods of application ; and the analysis and evaluation of commercial products. These are followed by a chapter on recently developed repellents to supplement the action of insecticides, and another in which notes are given of the successful use of the newer insecticides and repellents in various countries against Arthropods that transmit diseases of man or domestic animals. A final chapter deals with the agricultural uses of DDT and benzene hexachloride.

Shortt (H. E.). **Recent Research on Kala-azar in India.**—*Trans. R. Soc. trop. Med. Hyg.* **39** no. 1 pp. 13–31, 49 refs. London, 1945.

The history of research on visceral leishmaniasis (kala-azar) in India before 1922 is very briefly reviewed, and an account is given of work done subsequently, when effective means of treatment had been discovered and interest

was focused on transmission. Treatment and diagnosis are among the aspects dealt with. The course of epidemics in Assam since the introduction of the disease from Bengal in 1873 is described as typical of the history of such outbreaks in north-eastern India, where it occurs in typical and dermal leishmanoid forms [*cf. R.A.E.*, B **16** 249].

Theories on the method of transmission are reviewed. They concern direct and indirect contaminative transmission, and transmission by ankylostomes and by Arthropods, particularly *Phlebotomus*. A list is also given of ways in which experimental animals can be infected. Tests with ankylostomes were all negative, and although transmission can be effected by direct contamination and *Leishmania donovani* can survive for four days in milk or 24 hours in moist earth and withstand desiccation for four hours, the author is of the opinion that transmission by *Phlebotomus* is probably the normal method. He believes this view to be generally held, in spite of the comments of Malone & Brooks [**33** 153].

Literature on experiments on transmission by *P. argentipes*, Ann. & Brun., the only species with which satisfactory results have been obtained, is reviewed, from Mackie's work with an unidentified species of *Phlebotomus* [**3** 126–127] to the infection of five human volunteers on whom infected sandflies fed [**31** 143]. Notes are also given on the bionomics of *P. argentipes* [*cf.* **20** 254 ; **25** 59] and on the sequence of events in transmission experiments, before and after the technique of keeping the sandflies alive by feeding them on fruit juice was discovered [**28** 155 ; **29** 85]. Survival from one season of prevalence to the next is thought to occur chiefly, if not entirely, in the larval stage.

Hunt (A. R.) & Bloss (J. F. E.). **Tsetse Fly Control and Sleeping Sickness in the Sudan.**—*Trans. R. Soc. trop. Med. Hyg.* **39** no. 1 pp. 43–58, 1 pl., 4 figs., 13 refs. London, 1945.

Sleeping sickness (caused by *Trypanosoma gambiense*) was first recorded in the Tembura sub-district of Equatoria Province, which lies in the south-west corner of the Anglo-Egyptian Sudan, in 1918, when 255 cases were found. The district and the early control measures, which were directed to restricting the movements of the people so as to minimise contact between man and tsetse-fly, are described. Nearly all the rivers and streams of the area harbour *Glossina palpalis*, R.-D. In 1920, a sleeping-sickness settlement, where cases were segregated with their families, was founded at Sources Yubu, and a control scheme operated over an area of 300 sq. miles, taking in the Yubu from its source to the junction with the Mayuku and the whole of this tributary. New roads were cut, along the watersheds as far as possible, and the population forced to live along these roads. Protective clearings were made at all road-river crossings and watering places. The whole population was inspected monthly, and trans-frontier traffic and traffic through the infected area was restricted. These drastic measures were effective as long as they were rigorously enforced, but when they were less strictly carried out, the incidence of the disease again increased. In 1937, the regulations were amended, but the disease was not reduced as much as had been hoped. It was still endemic in 1938, and, after a report by C. B. Symes, who visited the area in the preceding year, trials were begun of his method of controlling *Glossina* by hand-catching in blocks of river bush isolated by barrier clearings at the ends [*R.A.E.*, B **24** 87 ; **25** 165].

Fly catches in the area covered by the block scheme showed that over 98 per cent. of all *Glossina* taken were *G. palpalis* subsp. *fuscipes*, Newst., and it is considered that this is the only vector, though *G. morsitans submorsitans*, Newst., and *G. fuscipleuris*, Aust., also occur [*cf.* **19** 13]. *G. morsitans* used to be more plentiful, and ponies and mules taken into the area quickly died of trypanosomiasis, until the people moved to the roads, when *G. morsitans* disappeared. In this area, it follows game rather than man, and game quickly

leaves settled areas as the people are persistent hunters. Cases of sleeping sickness caused by *T. rhodesiense* had been recorded from the area in 1922 [**10** 234] and 1926.

The progress of the control scheme and the routine followed are described. Blocks were established progressively from 1938 until 1941 and were made longer than the Kenya ones on account of the lower density of tsetses. The barrier clearings, of which there were five, were 800 yards long and 400 yards wide, and, for economy, two were situated at road and river crossings where previous small protective clearings had been made. This was not altogether satisfactory as traffic attracted fly, and the length of one clearing had to be increased. However, the small numbers of tsetses caught in the clearings indicated that these were fairly effective. In view of low fly catches in 1943, maintenance work was stopped in all barrier clearings except the furthest downstream beyond which there was no fly catching. The catches made in the various blocks in the area, expressed as flies caught per boy week, are shown for each month of the five year period 1938–43 in which catching was done in the block in question. Catches of 30 per boy week were found to be equivalent to one per boy hour. Catches were reduced very rapidly in all blocks and had reached very low levels (usually less than ten per boy week) within six months of the commencement of catching, but the maintenance of these low densities was difficult. The aim was to maintain an even density of five tsetses or less per boy week, and this was being done over most of the area by 1943. Like Teesdale [**29** 1], the authors found no evidence that the fly would die out once the population was sufficiently reduced. Catches tended to rise in the rainy season.

The incidence of sleeping sickness throughout the district decreased after 1923, when the population was moved to the roads. A large proportion of the cases that occurred originated at the River Yubu. The highest number traced to this area in any one year was 300 in 1923 and the lowest number three in 1942. These three were all from one block where a pocket of fly-infested country was discovered. There were 65 cases in 1938. Cases from the Yubu area formed 34 per cent. of the total for Tembura from 1928 to 1938, but by the end of 1942 they formed only 7 per cent. of the total. The fact that incidence in the area continued to decline after the people were allowed to move away from the roads is evidence of the effectiveness of the scheme. It is concluded that the experiment has provided valuable information concerning the possibilities of tsetse-fly control in the Anglo-Egyptian Sudan. Sleeping sickness is also endemic in the adjacent Oubangui Shari Province of French Equatorial Africa. Cross-frontier traffic with the natives of the other side is impossible to stop and difficult to control effectively. The fly control area is now a barrier to the disease.

Bloss (J. F. E.). **The Meridi Outbreak of Sleeping Sickness.**—*Trans. R. Soc. trop. Med. Hyg.* **39** no. 1 pp. 59–76, 1 pl., 3 figs., 2 refs. London, 1945.

An account is given of a localised epidemic of sleeping sickness (caused by *Trypanosoma gambiense*) that broke out in February 1941 near Meridi in Equatoria Province of the Anglo-Egyptian Sudan, a district to which no cases had previously been traced. It was comparatively severe, taking into consideration the small population, and is suspected of having originated in the Belgian Congo. The district and the distribution of the population are described. The outbreak began at the junction of a road and the river Eidi. *Glossina palpalis*, R.-D., was frequent along the upper course of this river, particularly in a small clearing where the road crossed it. As the forest became more open down stream, *G. morsitans*, Westw., became the predominant fly. It appeared to vary its habitat with the movements of game. The danger that

the disease might spread to areas in which it had not previously occurred and *G. palpalis* was prevalent was serious, and a block system of control for this fly, based on the work done at Sources Yubu [see preceding abstract], was started.

The first barrier clearing was made near the site of the original outbreak and the second and third 6 and 11 miles downstream. The people were not allowed to live or cultivate land in the control area, except along the roads, and hunting was forbidden and also travelling except along new roads. The whole population was examined every three months. By the end of 1941, 47 cases had been found, all infected locally, and there were 25 new cases in 1942, four of them probably infected on the Naam outside the control area, and a further nine in 1943, three probably infected on the Eidi and six on the Naam. Just before the outbreak was discovered, some people had moved from the place in which it began to a road running south-east to the Naam.

Details are given of the methods of control tried in the various localities. The first barrier clearing on the Eidi was 800 by 300 yards and the other two 600 by 300 yards. The fly catches in each of the blocks per boy week for each of the months from April 1941 to November 1943 are shown. By the end of 1941, no cases could be traced to the area of river covered by the second block, and as most of the catches there were *G. morsitans*, fly control was stopped. Restrictions were removed from the block in 1943. Owing to difficulty of maintenance, the width of the first and second clearings was reduced after 1941 to 50 yards from the river's edge; these rod clearings [*cf. R.A.E.*, B **30** 117] were effective.

When a trial fly-catch was made on the Naam in June 1942, the incidence at a point where a road crossed the river, one of the best all-the-year-round watering places in the district, was found to be over 40 per boy hour. A central clearing measuring 100 yards square was made and from this two rod clearings 25 yards wide on either side of the river extended for 200 yards. Seven boys stationed along these clearings in July caught 209 flies per boy week in the first week (the highest recorded catch in the Sudan) but less than 10 per boy week in December. In this month, bamboo and thatch screens put across the river at the ends of the clearing and extending ten yards up either bank were also tried. They considerably reduced catches and their use was extended to other clearings. In order further to improve efficiency, two secondary staggered screens were placed behind the first and further out from the river so that their inner ends overlapped the ends of the central screen. These screens were intended to guide any flies more than ten yards from the water's edge back to the river. A fly boy was stationed on the forest-side of the central screens. There was no fly catching in the river in territory at either end of the clearing, but even when incidence was high, it was kept low in the centre of the clearing.

Two cases of sleeping sickness were traced to the upper Mbaraba, which enters the Meridi about three miles south of Meridi town. The people concerned had recently moved to the area from the Eidi. In view of the danger to the town, a barrier clearing with staggered screens was placed at the junction of the two rivers and a narrow one near the town, and the block was patrolled from May to December 1942. As no further cases had been recorded early in 1943, fly control was stopped.

The comparative merits of the block system of control with continual fly catching and the system of rod clearings with periodic test catches are discussed. Maintenance is difficult in the former. Rod clearings are destructive of forest, as the densest, most luxuriant and valuable timber is closest to the stream. From observations on epidemiology, it is concluded that sleeping sickness can establish itself even when fly incidence is low, so that fly control measures have to be very thorough. An incidence of under five per boy week with continual daily catching was considered safe. The incubation period is long. Cases are rarely found within six months of infection and sometimes not for a year. Attention

is drawn to the fact that 30 cases occurred in ten homes. Spread of the disease within households has not previously been recorded; possible causes of it are briefly discussed.

MARIANI (G.). *Pediculus humanus*: **biologia in rapporto alla disinfestazione.** [The Biology of *P. humanus*, L., in Connection with Disinfestation.]—*Riv. Biol. colon.* **4** fasc. 4–5 pp. 237–261, 11 figs. Rome, 1941.

MARIANI (G.) & ARCHETTI (I.). **Ricerche sulla disinfestazione spontanea dal** *Pediculus humanus*. [Research into spontaneous Disinfestation from *P. humanus*.]—*Op. cit.* **5** fasc. 3–4 pp. 79–88, 2 refs. Rome, 1942.

In the first of these papers, the author gives the results of laboratory observations carried out in Addis Ababa, Abyssinia, on the effect of temperature on the development of *Pediculus humanus*, L., and compares them with those recorded in the literature [*cf. R.A.E.*, B **32** 162, etc.]. He does not distinguish between the two races, *humanus*, L. (*corporis*, Deg.) and *capitis*, Deg., which are equally common on Abyssinians, irrespective of age, sex or social position, but most or all of his work was apparently done with body lice. The optimum temperatures for the eggs, nymphs and adults were 35, 32 and 33°C. [95, 89·6 and 91·4°F.]; the upper thresholds of development, above which they die from desiccation, were 36, 35 and 38°C. [96·8, 95 and 100·4°F.]; and the lower thresholds, below which they remain alive but inactive, were 21, 18 and 15°C. [69·8, 64·4 and 59°F.]. In the laboratory at 35°C., the egg and nymphal stages lasted 6 and 10 days, with 25 and 20 per cent. mortality, respectively, and adults survived for 30 days. The average number of eggs laid per female was 188 under favourable conditions and 92 under normal ones, but it was found that the infestation of individual hosts did not increase beyond a certain point; of many Abyssinians examined in Addis Ababa, only 2–3 per cent. harboured more than 500 lice.

In connection with observations on resistance to starvation at various temperatures, notes are given on consignments of eggs, nymphs and adults received by air from Poland in 1939; the journey took nine days and high and low temperatures were experienced. Some of the nymphs and adults were alive on arrival, though they had not been fed, and some of the adults had laid viable eggs. Of the consignment of eggs, which had been laid 1–2 days before despatch, about 20 per cent. hatched on the journey and about 8 per cent. after arrival, but mortality of the resulting nymphs was high.

When protected from direct sunlight and given no food, nymphs and adults all died in less than 12 days at natural temperatures above 25°C. [77°F.]. Resistance to starvation was greater between 5 and 20°C. [41–68°F.], and the eggs survived for more than 12 days and hatched when transferred to a higher temperature. In Abyssinia, infestation is greater during the rains (June–September) than in the hot, dry season, and this is attributed to the fact that the people crowd together indoors during the rains, while in fine weather their clothing is lighter and more airy.

Of lice reared by the author in the laboratory 95 per cent. were free from microorganisms in the digestive tract, but of those taken in nature, less than 50 per cent. were free. The organisms found included the spirochaete of relapsing fever (*Spirochaeta recurrentis*) and the rickettsia of epidemic typhus (*Rickettsia prowazeki*), as well as *R. pediculi* and *R. rocha-limae*. There appears to be no immunity from louse-borne relapsing fever in Abyssinia, but this disease is much less common than typhus, probably because it can be acquired only by crushing or wounding infected lice, whereas typhus can be transmitted through their excreta. Methods of prophylaxis and disinfestation are reviewed from the literature.

The second paper contains the results of tests on the survival at different temperatures of eggs, and starved nymphs and adults. Eggs exposed on pieces

of cloth survived for a few hours at −20 to −30°C. [−4 to −22°F.], for 12 hours at −10°C. [14°F.], for at least five days at 0°C. [32°F.] and for six days at 20°C. [68°F.]. They did not hatch at 20°C., but hatched in 14-4 days at constant temperatures of 22–36°C. [71·6–96·8°F.], the incubation period varying inversely with the temperature. By varying the temperature within the range of 16–30°C. [60·8–86°F.], the incubation period was extended to 3–4 weeks. Nymphs that hatched from eggs kept at 30°C. and were not fed died in a few hours or minutes between −10 and −30°C. and in 40 hours between 30 and 38°C.; they survived for up to eight days at 10°C. [50°F.] and up to five days at 23–24°C. [73·4–75·2°F.]. Lice that had hatched 20–30 days previously and had fed very little as adults survived for a few hours at −20°C. and under, for a maximum of 48 hours at 30°C. and over, for a few days at about 0°C. or at 23–24°C., and for 11 days at 10°C. Females kept at 23–35°C. oviposited. Excessive humidity was harmful at low temperatures and dry air at high ones.

The authors conclude that the constant temperature at which *P. humanus* is most resistant to starvation is 23 24°C., at which infestation can persist in clothing for up to 23 days; at varying temperatures, it can persist for up to 43 days. For natural disinfestation of clothing, the most favourable temperatures are 30°C. and over, particularly if the atmosphere is dry, when the lice die out within 11 days, or 15°C. and under, when all stages die in 12 days. It is pointed out, however, that *Rickettsia prowazeki* and *Spirochaeta recurrentis* are more resistant to low temperatures than their vectors and sometimes survive for several days after the latter have died.

Starkoff (O.). **Sul potere patogeno delle larve di *Gasterophilus intestinalis* (De Geer, 1776) : contributo sperimentale ed anatomo-patologico.** [On the pathogenic Power of the Larvae of *G. intestinalis* : an experimental and anatomo-pathological Contribution.]—*Riv. Biol. colon.* **5** fasc. 3-4 pp. 89–106, 4 figs. Rome, 1942.

The author reviews the literature on the effect on horses of infestation of the stomach by larvae of *Gasterophilus intestinalis*, Deg., and describes his own observations. The larvae have been considered to contain a substance that is toxic to horses [*cf. R.A.E.*, B **10** 88; **11** 31; **17** 94]; but in the experiments described, aqueous extracts of larvae of *G. intestinalis*, at a dilution of 1 : 10 by weight, injected into rabbits in 10 cc. doses intraperitoneally and intravenously on alternate days for more than a month, caused no general toxic symptoms, no anaphylactic reactions and no modification of the red blood corpuscles, though they caused some eosinophilia in the peripheral blood and considerably more in the marrow. He concludes that the harmful effects of the infestation in horses are due to the ulceration of the stomach by the larvae.

Travassos (J.) & Vallejo-Freire (A.). **Criação artificial de *Amblyomma cajennense* para o preparo da vacina contra a febre maculosa.** [Artificial Rearing of *A. cayennense* for the Preparation of Vaccine against Spotted Fever.]—*Mem. Inst. Butantan* **18** pp. 145–235, 32 figs. (4 col., 1 fldg.), 36 refs. São Paulo, 1945.

In view of the spread of spotted fever in Brazil and the consequent increased demand for vaccine, the authors give a detailed account of the technique employed in São Paulo for its preparation from ticks, including precautions for the protection of the workers who rear them. The method is based on that of Spencer & Parker [*R.A.E.*, B **14** 4], and the tick employed is *Amblyomma cayennense*, F., which is a natural vector [*cf.* **27** 36] and a common parasite

of horses. Its life-history is briefly described, and descriptions of the larvae, nymphs and adults are quoted. Engorged females are collected each year from horses between October and March, washed and dried under a fan and placed singly in tubes in an outer container having damp sand in the bottom to supply the necessary moisture. When large numbers of ticks are involved, groups of 100 tubes are placed in a single large outer container.

During 1939–43, rearing at laboratory temperature was compared with rearing at higher constant temperatures, and the results are shown in detail in tables and graphs and discussed. At a constant temperature of 26°C. [78·8°F.] and 90 per cent. relative humidity, and at the laboratory temperature of late summer (averaging about 22°C. [71·6°F.]), most of the females began to oviposit about seven and six days after collection, respectively, and oviposition continued for averages of 13·7 and 23·3 days. The numbers of eggs laid per female for four examples kept at laboratory temperatures ranged from well over 5,000 to nearly 10,000. The eggs of females that completed oviposition normally were almost all viable, and hatched in an average of 21·7 days at 26°C. and 25·5 days in the laboratory; hatching of a given batch of eggs lasted about 2–3 weeks.

It was found that at the laboratory temperatures of May and June, at least 32 days, and preferably 38–40, should be allowed to elapse between the end of hatching and the first infecting feed, to allow the chitin of the larvae to harden. This period can be prolonged by keeping the larvae at about 15°C. [59°F.]. They are fed on the ears of artificially infected rabbits, about 14,000 being enclosed for 8–10 days on each ear. The rabbits are then killed, the ears removed, and the engorged larvae collected, washed, dried and returned to the containers.

Engorged larvae moulted after 5–15 days at a constant temperature of 30–32°C. [86–89·6°F.] and after 7–35 days in the laboratory, development being slowest in the coldest months, June and July. Of 172 lots kept in the laboratory in these months, only 23 gave a high proportion of nymphs. At 30°C., all the larvae in 36 of 152 lots moulted successfully, and only 33 lots gave less than 40 per cent. nymphs, but it was necessary to remove the nymphs to a lower temperature soon after moulting, as continued exposure to 30°C. killed them.

At laboratory temperature, a delay of 30–40 days was found advisable before allowing the nymphs to engorge, which was done as before on infected rabbits. Engorged nymphs that were kept at 30–32°C. moulted after 9–12 days, 80–90 per cent. surviving to become adults in more than half the lots observed. The adults also needed to be removed as soon as possible to a lower temperature. At laboratory temperatures in June–July, the final moult did not take place for 23–60 days after feeding, and less than 20 per cent. of the nymphs became adults. In October–November, moulting began after 23–30 days. For practical purposes, a maximum temperature of 28°C. [82·4°F.] is recommended; routine rearing is done at 24–26°C. [75·2–78·8°F.], and even so, it is found inadvisable to leave the ticks in the incubator any longer than necessary.

The adults are transferred to cardboard pill-boxes each holding 150–200, and these are enclosed in groups of ten in muslin bags and stored in metal boxes, the necessary humidity being provided by a layer of wet cotton wool beneath a perforated metal sheet. The ticks are kept in a refrigerator at 10–15°C. [50–59°F.] until they are required for the preparation of vaccine, usually about six months later, and since the rickettsiae do not multiply actively under these conditions, a stimulating feed on rabbit or guineapig is given before the ticks are used; they are first kept for 24 hours at 37°C. [98·6°F.], and when they have fed for 4–6 days, they are kept at laboratory temperature for 48–96 hours, as maximum virulence is developed 8–10 days after the beginning of the stimulating feed. The infectivity of the ticks is tested, and only batches furnishing not less than 1,000 infecting doses per tick are used [*cf.* **14** 4].

VISWANATHAN (D. K.). **Studies on Malaria in Infants in North Kanara District, Bombay Presidency.**—*J. Malar. Inst. India* **6** no. 1 pp. 1–38, 4 charts, 8 refs. Calcutta, 1945.

This paper includes an account of observations made in 1943–44 in which there was shown to be a fairly close co-relation between malaria parasite rates in infants in a town and a large village in North Kanara District, Bombay Presidency, and the seasonal fluctuation in local abundance of adults of *Anopheles fluviatilis*, James, the vector in this district [*cf. R.A.E.*, B **33** 168]. Adults were caught from fixed catching stations for a specified time each week. General collections were also made on a timed basis, and the density of *A. fluviatilis* reckoned as the number caught per ten man-hours each month. There were indications that a density of 4 per ten man-hours is adequate to bring about effective transmission in this district.

In the town, there was a well-defined season of transmission from September to December. The population of *A. fluviatilis* rose suddenly in September and remained steady in October and rose sharply again in November and December. Fresh infection in infants rose sharply in September until the maximum for the *fluviatilis* population was reached, fell away in October and rose again in November and December to the September level. Transmission to children and adults, estimated from dispensary records, continued in October. The defect of infant infection in October shows that fallacious inferences regarding the yearly quantum of transmission may be drawn from infant parasite rates if the examination is made in only one month, even though that month is in the middle of the transmission period. The fallacy will be obviated if the examinations are made in the month in which dispensary admissions reach their peak. In the village, the transmission season extended throughout the year except for the monsoon months of July to October, when the population of *A. fluviatilis* was very low owing to scouring of breeding places by heavy rain.

RAJINDAR PAL. **On the Bionomics of *Anopheles culicifacies* Giles. Part II. The Ecology of the immature Stages.**—*J. Malar. Inst. India* **6** no. 1 pp. 53–74, 2 figs., 25 refs. Calcutta, 1945.

The following is mainly based on the author's summary of this paper, which comprises an account of observations on the breeding places and time of oviposition of *Anopheles culicifacies*, Giles, and the influence of environmental factors on the gravid females and immature stages, carried out at Delhi in continuation of investigations on length of life, made at Lahore in 1940 [*R.A.E.*, B **32** 150]. Oviposition usually took place at night, and of eggs deposited between 7 p.m. and 4 a.m., 60·1 and 87·9 per cent. were deposited before 10 p.m. and 1 a.m., respectively [*cf.* **31** 75]. The average numbers of eggs laid by females in captivity at different times of the year were more or less constant (115–134). Females given the choice between water at 100·4°F. (room temperature) and 107·6 or 113°F., showed a slight preference for the cooler water in the first case and a distinct preference in the second. A study of oviposition on water of various types (irrigation, tap or reservoir water, muddy pond or rain water or stagnant, distilled or soapy water) in cages and a survey of natural breeding places showed that the females deposit eggs at random without exercising selection, except that soapy water was avoided. They appeared to lay their eggs indiscriminately in water containing up to 120 parts per million of free and saline ammonia [*cf.* **23** 129] and *A. subpictus*, Grassi, and *A. annularis*, Wulp, behaved in the same way. Larvae of the three species, however, failed to develop in concentrations of free and saline ammonia exceeding 12 p.p.m. *A. culicifacies* was fairly sensitive to pollution by decaying vegetation. Eggs were not deposited if the degree of pollution (albuminoid ammonia × 50 +

Tidy figure × 5 [*cf.* **30** 103]) exceeded 1,224 p.p.m., and if it exceeded 1,064·5 p.p.m., all larvae placed in the water died. Shade itself had no appreciable influence on egg-laying, but mechanical obstruction by objects causing it exerted an inhibitory effect [*cf.* **31** 62, 118].

The development of eggs, larvae and pupae was followed at six constant temperatures varying from 68 to 104°F. The most favourable range for the development of all stages was 82·4–96·8°, the optimum being 89·6°. The thermal death points of the eggs, larvae of the four instars and pupae were 127·4, 115·3, 115·1, 113·9, 113·9 and 109·9°F., respectively [*cf.* **29** 70]. Temperatures slightly below these were lethal if exposures were prolonged. An extensive study of water temperatures in the field showed that the maximum temperature of some small breeding places in summer was as high as 112·8°F., and 109·4° was frequent. In May and June, water temperature seemed to be a limiting factor. Immature stages were rare when it rose above 104°F. for long periods, and females were observed to oviposit in wells and reservoirs, where the temperature is relatively low. The maximum water temperatures prevailing from December to February (50–59°F.) were not lethal to the early stages but greatly retarded development, so that the life-cycle from egg to adult often took three months. Eggs invariably perished at temperatures below 50°F., and larvae and pupae were generally killed at temperatures below 41°. In nature, the temperature of the water in the breeding places in central and southern Punjab never falls below 8–10°C. [46·4 50°F.], so that *A. culicifacies* breeds uninterruptedly through the winter.

BADRI NATH MOHAN. **Details of the Procedure adopted in maintaining a laboratory Colony of** *A. fluviatilis*.—*J. Malar. Inst. India* **6** no. 1 pp. 75–76. Calcutta, 1945.

When this paper was written, a colony of *Anopheles fluviatilis*, James, had been kept for more than a year at Mettupalaiyam, a town 17 miles east of Coonoor and about 1,000 ft. above sea level, and was apparently in a vigorous condition. It was started from eggs laid on moist filter paper by females caught in nature and isolated when gravid in tubes plugged with moistened cotton-wool. The eggs were floated on water inside paraffined cork rings in large enamel receptacles. Hay infusion and a mixture of two parts litmus milk and one part dehydrated blood serum, or, failing this mixture, dried brewers' yeast, were added occasionally to each basin, and the water was aerated vigorously once a day. Mortality among larvae was reduced by lining the basins with mud and drying this in the sun before use. Pupae were kept inside a colony cage in a bowl of clear water, on which a few blades of grass were floated to provide a foothold for emerging adults.

The colony cage, which was kept inside a larger cage with wooden sides and a glass top, measured about two feet cubed. The bottom was tin sheet and the side and top were fibre-board, with a cloth sleeve entrance measuring 10 × 10 ins. in the front and a central wire-gauze area measuring 2 × 2 ins. on the top. Humidity was increased by keeping a screened tray of saturated solution of common salt in the cage and suspending pieces of cloth. A rabbit shaved on the back or a fowl or guineapig was placed in the cage each night, and there was a supply of 10 per cent. glucose water on cotton-wool in tubes in a wooden rack. Water for oviposition was provided in enamel bowls or earthenware pots lined with mud. Many more eggs were laid in the pots than in the white bowls, probably on account of the colour of the background. Pairing took place in the cage only in the presence of a blue light. This was provided by a blue bulb above the gauze patch.

In other studies, it was observed that females that had oviposited were much less reluctant to feed on rabbits than those that had not. This implied that

the colony cage must be stocked with a large number of mosquitos until eggs are obtained abundantly and continuously.

RAMACHANDRA RAO (T.). **Behaviour of *Anopheles fluviatilis*. Part III. Larvae Habitats in North Kanara District.**—*J. Malar. Inst. India* **6** no. 1 pp. 77–82, 9 refs. Calcutta, 1945.

In this third paper of a series on the behaviour of *Anopheles fluviatilis*, James, in North Kanara District, Bombay Presidency [*R.A.E.*, B **33** 47; **34** 194], summarised data, based on extensive collections made between August 1942 and December 1944, are given on habitats of the larvae. These data in general confirm the observations of Jaswant Singh & Jacob [**33** 168]. The number of times Anopheline larvae of any species were found (positive searches), the total number of larvae of all species collected, the number of times larvae of *A. fluviatilis* were collected and the number of this species taken, are shown for each of the important types of breeding places. Out of 9,526 positive searches made during the entire period, 799 yielded 2,557 larvae of *A. fluviatilis*. Of 3,616 positive searches in streams and channels, 493 yielded 1,678 larvae of *A. fluviatilis*. Though streams and channels with grassy margins are well suited to the larvae, they often occurred where there was no grass or other vegetation, but in this case there was usually considerable shade from overhanging bushes or high banks.

Out of 797 and 1,386 positive searches in fallow and growing rice-fields, respectively, 42 and 102 yielded 98 and 244 larvae of *A. fluviatilis* [*cf.* **28** 162]. The larvae were much more prevalent in rice-fields in 1944 than earlier in the period. The reason for this and the normal prevalence are unknown, but possible explanations are discussed. However, as the acreage of rice-fields around most towns and villages in the plateau section of North Kanara District is very great, their importance in relation to malaria may in some places be even greater than that of field channels and streams. No final conclusions were reached as to whether any type of rice-field was more favourable than others, but almost all the fields in which larvae were found had gently flowing water. The flow was due either to a direct supply from a channel or to seepage from a reservoir bund or high bank. In steeply terraced fields, the larvae were more often found along the upper edge of the field bordering the steep bank than in the more open lower side. In valleys with dwellings along one edge only, the larvae were more often found in the fields bordering that edge than elsewhere [*cf.* **33** 169]. The stage of rice growth did not seem to influence breeding. Larvae were found in almost all months from July to December in growing rice, but at any particular time they were more frequent in fields with thick than those with more open growth. In fallow fields, the larvae were always in thick grass, though this might be only 2–3 inches high. They were not found in the many shallow surface drains made to take away water from the rice just before harvest, unless grass grew heavily after the harvest was over. The time of their first appearance in the fields after the onset of the monsoon varied from place to place.

Out of 157 positive searches made in swamps (abandoned fields with flowing water and abundant vertical vegetation), 40 yielded 290 larvae of *A. fluviatilis*. This was the highest intensity of breeding found in any habitat, but these swamps are not common. The few that occur can be easily located and treated, but should not be ignored. The 75 wells that yielded *A. fluviatilis*, out of 906 that yielded Anopheline larvae, were mostly field wells near rice-fields with water almost at ground level and the edges almost always overgrown with grasses. Deep domestic wells in and near houses yielded practically no larvae of *A. fluviatilis*, but a few brick-lined wells with water very near ground level harboured some. Between August and December 1944, 57 positive searches were made in sugar-cane garden trenches and 49 larvae of *A. fluviatilis* were

collected in 22 of them. These trenches are really channels and are important sources of *A. fluviatilis*. Most of them have grassy margins, a slight flow of water and abundant shade.

SENIOR WHITE (R.). **House Spraying with D.D.T. and with Pyrethrum Extract compared : first Results.** —*J. Malar. Inst. India* **6** no. 1 pp. 83–93, 3 refs. Calcutta, 1945.

Malaria is hyperendemic in the neighbourhood of Chatikona Summit where the Raipur-Vizianagram railway line crosses the Jeypore Hills [*R.A.E.*, B **25** 190]. Spleen rates of about 90 per cent. are frequent, and transmission occurs throughout the year. The vectors are *A. fluviatilis*, James, *A. varuna*, Iyen., and *A. minimus*, Theo. *A. culicifacies*, Giles, *A. aconitus*, Dön., and *A. jeyporiensis*, James, also occur, but gland infections have never been found in them. The vector species are scarce in cattle sheds. Costly measures against the larvae were used at one time to protect the railway colony, and subsequently spraying with pyrethrum extract was introduced as a supplementary measure. In 1942, antilarval measures were abandoned and reliance was placed on the spraying of buildings with pyrethrum extract six days each week at ½ oz. per 1,000 cu. ft. Chatikona Village, ¼ mile away, was sprayed twice weekly at 1 oz. per 1,500 cu. ft. This was not often enough effectively to influence either density or infectivity [*cf.* **33** 135], and the procedure is useless to protect a population exposed to mosquitos of the *fluviatilis* group (*A. fluviatilis*, *A. varuna* and *A. minimus*), but it served to improve the protection afforded to the railway population by preventing infiltration of females infected in the village into the colony.

In 1944–45, experiments were carried out to compare the value of pyrethrum extract and DDT. A village of 48 houses was selected for treatment with DDT and they were sprayed with a 5 per cent. solution in grade III kerosene at the rate of 1 qt. solution (2 oz. DDT) per 1,000 sq. ft. of wall surface. Care was taken to wet all the wall surfaces, including the outside verandahs and the roofs as far as these were accessible, but not the floors. The many factors that made it difficult to treat completely all surfaces on which mosquitos rest are discussed. The railway colony was sprayed with pyrethrum six days a week and Chatikona village twice a week, and a third village was left untreated as a control. The results of mosquito dissections made each week in the four localities are given in tables. A gut infection was found in the village treated with DDT in the eighth week after treatment but no infection in the ninth week. After this, a second application was made. In the same and the following weeks, infection was high in the untreated village and the village treated with pyrethrum twice weekly. Pyrethrum spraying six days each week reduced density and length of life sufficiently to inhibit gland infections, though the reduction in density was much less than with DDT. This is probably because some of the mosquito population leaves a house before the morning spraying with pyrethrum, whereas it is believed that any female that, after feeding, has rested on a still active surface treated with DDT will die. It is concluded that DDT at the rate applied prevents infection of the members of the *fluviatilis* group for eight weeks in a hyperendemic area in the cold season of southern India. It acts by reducing density as well as length of life. Costs are discussed. For the period December to February, DDT was 20–25 times cheaper per head per week than the pyrethrum as applied for the protection of the railway colony.

DDT reduced the population of *A. culicifacies* by 81 per cent. in March and April, its season of prevalence, as against a 49 per cent. reduction effected by pyrethrum applied twice weekly. This dosage of pyrethrum is generally considered adequate for the control of *A. culicifacies*, the capacity of which to transmit malaria appears to be mainly governed by density.

Subbarao (D.) & Apparao (M.). **Malaria Transmission in and around Vizagapatam.** (Abstract.)—*J. Malar. Inst. India* **6** no. 1 pp. 95–96, 3 refs. Calcutta, 1945.

A list is given of the 14 species of *Anopheles* found during observations made from September 1942 to October 1944 on the transmission of malaria around Vizagapatam, where its incidence is usually low but localised epidemics sometimes occur. They included *A. stephensi*, List., and *A. culicifacies*, Giles. Though infections had occasionally been found in the latter in the past, the conclusion had been reached that it played no important part in spreading the disease [*R.A.E.*, B **33** 45]. During an epidemic in 1942, the authors recorded one gland infection in *A. stephensi* (of undetermined race) out of 165 dissected in a village near Vizagapatam and one gut infection in *A. culicifacies* out of 395 dissected. In the town itself, one gut infection was found in 52 females of *A. stephensi* dissected in September, and seven, two and one gland infections in 139, 37 and 48 dissected in October, November and December, respectively. Dissection of 43 and 128 females of *A. culicifacies* in October and November, respectively, yielded one gland infection in each month.

The principal breeding places of *A. stephensi* were seepage outcrops in water courses in the rural area, and wells and artificial containers in the town. Adults were rare in well-built houses but plentiful in thatched huts and cattle sheds. Of 11 infected females collected in the town, only one (with a gut infection) was caught in a house, whereas five (all with gland infections) were taken in cattle sheds and five others in huts occupied by both man and cattle. In rural areas, adults were seen resting at dawn in the thatched verandahs or under the projecting eaves of huts. The oöcyst and sporozoite rates among 388 females of *A. stephensi* collected in the town from September 1942 to October 1944 were 0·26 and 2·6 per cent., respectively, and among 304 collected in the rural area both were 1·3 per cent. Infections were noted in every month from September to May inclusive. Among 11 infected females, the race of which was determined by measuring the eggs, 6 out of 7 from the town were typical and 3 out of 4 from rural areas were var. *mysorensis*, Sweet & Rao. The percentage infections for the two races were 6·9 and 4·8, respectively, and the sporozoite indices 6·9 and 2·4. It is concluded that both are efficient vectors and have been responsible for epidemics in both urban and rural areas, var. *mysorensis* predominating in the latter area and the typical race in the town.

The infection and sporozoite rates in *A. culicifacies* were 0·58 and 0·19 per cent., respectively. Infections were recorded in August, October and November. In the town, one gut and two gland infections were found in 844 females dissected, and in the country, where 8,143 females were dissected, one gut infection was recorded among 510 collected in one locality, the remaining 7,633 being negative. One additional gland infection was observed among 234 females dissected in January 1945.

The authors conclude that *A. culicifacies* plays a definite, though possibly a secondary, part in the transmission of malaria in and around Vizagapatam, especially in conditions favourable for epidemic incidence.

Viswanathan (D. K.). **Malaria Survey of Salsette Island.** (Abstract.)—*J. Malar. Inst. India* **6** no. 1 p. 97. Calcutta, 1945.

A malaria survey of Salsette Island [near Bombay] was made in July–August and October–November 1943. The disease is hyperendemic in the central hill and foothill region, where the spleen rate is over 50 per cent., and becomes moderately endemic at a distance of about two miles from the hills and their spurs. The coastal towns and villages to the west of the hills are more than two miles away in several places and show no evidence of endemicity at any season. In the coastal strip to the east, which is narrow and mostly within

two miles of the foothills, malaria is moderately endemic with a definite seasonal rise from September to November, and in this coastal strip outbreaks mainly due to variation in the distribution rather than the amount of rainfall and indicative of transmission by a stream-breeding Anopheline occur from year to year.

Out of 191 females of *A. fluviatilis*, James, dissected during the season, 16 were positive either for oöcysts or sporozoites. This species is thought to be the only important vector. It breeds principally in hill streams and channels flowing down the slopes past the coastal strips into creeks. These streams are flushed during the monsoon, and hence breaks in the monsoon increase the risk of transmission. Malaria incidence is high throughout the hills and foothills, but there are foci of different degrees of prevalence on the coast. Although *A. fluviatilis* varies markedly in abundance at different seasons on the top of the hills and foothills, it is always present in sufficient numbers to account for hyperendemicity and a poor recovery rate during the off-season. It is relatively sparse in the coastal areas to the east of the hills, but its preference for human blood to the exclusion of all other and its efficiency as a vector account for the sharp seasonal rise in the incidence of malaria.

Soman (D. W.). **Malaria in Pandharpur, Bombay Presidency.** (Abstract.)—*J. Malar. Inst. India* **6** no. 1 pp. 99–100. Calcutta, 1945.

A malaria survey of the town of Pandharpur, a pilgrim centre 265 miles south-east of Bombay in the district of Sholapur, Deccan, 1,500 ft. above sea level, was carried out from September 1937 to May 1938. The spleen rate in the Railway Colony, where regular treatment is provided, was 15 per cent. Urban rates were generally low, but 22 per cent. was recorded in one quarter of the town and 33 per cent. in another. Of 546 blood samples, 170 were positive. Anophelines bred chiefly in the river bed, the edges of a large reservoir, leakages from the irrigation system emanating from it, quarry-pits and collections of rainwater. A list is given of the 13 species of *Anopheles* found. Between December and May, 629 females of *A. culicifacies*, Giles, 43 of *A. stephensi*, List., 88 of *A. subpictus*, Grassi, 82 of *A. annularis*, Wulp, 16 of *A. turkhudi*, List., and one of *A. vagus*, Dön., were dissected, but the only infection found was in the gut of one female of *A. culicifacies* out of 206 dissected in December. It is presumed that transmission begins with the monsoon in June and continues until the end of the year. The measures taken included minor levelling and drainage operations, the application of larvicides to breeding places and the use of pyrethrum sprays in dwellings.

Livadas (G. A.) & Sphangos (J. C.). **Malaria in Greece (1930–1940). Research-Control.**—$9\frac{3}{4} \times 7$ ins., vol. i, viii+238 pp., 19 pls. (7 col.), 86 figs., refs., 1941; vol. ii, vi+299 [+1] pp., 18 pls., 246 figs., refs., 1940. Athens [Sch. Hyg.] 1940–41.

The first volume of this monograph comprises brief descriptions of the topography, climate, natural resources and administrative divisions of Greece, a review of its health organisations and the anti-malaria campaign services, and data on the history and prevalence of malaria, as well as an account of research carried out between 1930 and 1940 on Anophelines, malaria parasites and epidemiology and anti-malaria measures. The major drainage works are to be dealt with in a supplementary publication. The second volume contains descriptions of local anti-malaria campaigns in various parts of the country, with conclusions regarding their effectiveness.

From a review of the literature and their own observations, the authors conclude that eight species of *Anopheles* are found in Greece [*cf.* *R.A.E.*, B **24** 48]. They make no mention of *A. italicus*, Raff., and consider that the

forms of *A. maculipennis*, Mg., definitely known to occur are *typicus* and *subalpinus*, Hackett & Lewis, *sacharovi*, Favr (*elutus*, Edw.) being treated as a distinct species. They state that before the eggs of var. *subalpinus* were described [**24** 36], these were thought in Greece to belong to var. *messeae*, Fln., and that as extensive searches have revealed no typical eggs of *messeae* in Greece, earlier references to this mosquito probably apply to *subalpinus*. However, in 1936, Bates reported finding eggs of *messeae* on the Albanian shore of lake Prespa, and no opportunity has arisen for searching on the Greek side. The geographical distribution and breeding places of the various species and their morphology and bionomics, including food preferences and duration of digestion of a blood-meal in domestic species, and also the importance of the various species in the transmission of malaria, are discussed. Only *A. superpictus*, Grassi, and varieties of *A. maculipennis*, including *sacharovi*, are thought to be considerable vectors. Malaria is endemic throughout the country [*cf.* **26** 207] except in some mountainous regions, and there are more or less severe epidemics every 2–5 years. Malaria morbidity and mortality are both highest in August, September and October, and the rural areas are much more malarious than the towns.

The discussion of anti-malaria measures includes accounts of methods of protecting houses and individuals against Anophelines, and a comparison of the merits against Anopheline larvae of oil, 1 per cent. Paris green in road dust and a mixture of Paris green and kerosene diluted with water [**34** 66]. *Gambusia* has been widely distributed in Greece to effect natural control. Very brief reference is made to the methods of dealing with small swamps near inhabited areas (filling, subsoil drainage and drainage by open ditches), the drainage of coastal swamps, regulation of irrigation water, intermittent irrigation of rice, control of water from artesian wells, and the elimination of breeding places in torrent beds.

Corrêa (R. R.) & [da Silva] Ramos (A.). **Os Anofelinos da Ilha de Santo Amaro.** [The Anophelines of the Isle of Santo Amaro.]—*Arq. Hig. Saúde públ.* **9** no. 22 pp. 7–16, 2 figs., 11 refs. São Paulo, 1944. (With a Summary in English.)

A survey from the middle of 1939 to February 1943, in which numerous larvae and adults were taken, showed that the species of *Anopheles* present on the island of Santo Amaro, on the coast of São Paulo, Brazil, were *A. aquasalis*, Curry (*tarsimaculatus*, auct., *oswaldoi guarujaensis*, Ramos) [*cf. R.A.E.*, B **32** 91; **36** 3], *A. oswaldoi*, Peryassú, *A. strodei*, Root, *A. intermedius*, Chagas, *A. eiseni*, Coq., *A. cruzi*, D. & K., *A. bellator*, D. & K., *A. kompi*, Edw., and *A. mediopunctatus*, Theo. *A. aquasalis*, which is known to transmit malaria [**31** 237] was by far the commonest Anopheline in houses; *A. oswaldoi* was the most numerous in animal shelters, but uncommon in houses. Many larvae of *A. eiseni* were taken, but only five adults; in laboratory tests, females of this species were reluctant to feed on blood [*cf.* **31** 141], and it is suggested that it may be autogenous.

Batista (D.). **O paludismo e a Amazônia.** Malaria in the Amazon Region. —*Rev. med.-cirurg. Brasil* **53** no. 9–10 pp. 299–314. Rio de Janeiro, 1945.

Malaria, caused chiefly by *Plasmodium vivax* and transmitted by *Anopheles darlingi*, Root, is endemic in the Amazon Valley, but occasional outbreaks occur, as in Maués in 1940–41. Attempts at control are being made in association with United States workers, but have not so far proved particularly successful. The area concerned is vast and domestic conditions largely

primitive, so that the problem is considered by the author as largely a social one. He advocates intense localised campaigns for Anopheline control by the usual methods as a basis for future work, combined with medical prophylaxis and improved social conditions.

MARA (L.). **Considerazioni sul rinvenimento dell' *Aëdes aegypti* L. (Dip., Aedinae) ad altitudini d'eccezione e brevi note sulla fauna culicidica del M. Bizen (Eritrea, A. O.).** [Considerations on the Discovery of *A. aegypti* at exceptional Altitudes and brief Notes on the Culicine Fauna of Mount Bizen, Eritrea.]—*Boll. Soc. ital. Med.* (*Sez. Eritrea*) **5** no. 5–6 pp. 189–198, 16 refs. Asmara [1946]. (With a Summary in English.)

The author reports the discovery in September 1945 of larvae of *Aëdes aegypti*, L., in all stages of development in two rainwater pools on the summit of Mount Bizen, Eritrea, at an altitude of over 7,800 ft., and also of a few second- and third-instar larvae of *A. aegypti*, in association with numerous larvae of *Culiseta* (*Theobaldia*) *longiareolata*, Macq., and four species of *Culex*, in an open water storage vessel in a nearby village. The discovery was unexpected since *A. aegypti* had not previously been found in Eritrea above about 5,400 ft. and was thought not to develop at temperatures below 20°C. [68°F.] [but *cf. R.A.E.*, B **35** 185], whereas the average monthly temperature on Mount Bizen ranges between 15·3°C. [59·54°F.] in December and 19·7°C. [67·46°F.] in April.

BETTINI (T. M.). **L'importanza della lotta contro le glossine (*Glossina* spp.) quale profilassi de alcune tripanosi dell'A. O. I.** [The Importance of combating *Glossina* spp. as a preventative Measure against certain Trypanosome Diseases in Abyssinia, Somalia and Eritrea.]—*Agricoltura colon.* **35** nos. 10–11 pp. 374–382, 415–424, 4 figs., 1 map, many refs. Florence, 1941.

In this paper, which is based largely on the literature, the role of *Glossina* spp. in transmitting trypanosomiasis of animals is discussed, and methods employed in combating the flies in the various regions of Africa are described and compared. Their distribution in the African continent is shown on a map, and an account is given of the local distribution of the species present in Abyssinia and Somalia [*cf. R.A.E.*, B **25** 39; **26** 154; **28** 22, 142]; none is recorded from Eritrea. The most important of the trypanosomes in domestic animals in these countries are *Trypanosoma brucei* and *T. congolense*, which are transmitted by *Glossina* in Somalia and Abyssinia; *T. vivax* is transmitted by *Glossina* in Somalia and *T. vivax* and *T. evansi* also by other blood-sucking flies in Somalia and Eritrea. *T. theileri* occurs in Eritrea, Somalia and Abyssinia, but its vector is unknown.

PAPERS NOTICED BY TITLE ONLY.

BLAGOVES[H]CHENSKY (D. [I.]), BREGETOVA (N. [G.]) & MONCHADSKY A. [S.]. **An Investigation on new Repellents for the Protection of Man against Mosquito Attacks.**—*Trans. R. Soc. trop. Med. Hyg.* **39** no. 2 pp. 147–150, 8 refs. London, 1945. [*Cf. R.A.E.*, B **33** 15.]

LOMBARDINI (G.). **Contributo alla conoscenza della morfologia dei Demodicidae. Chiave analitica del genere *Demodex* Owen.** [A Contribution to the Knowledge of the Morphology of the Demodicidae, with a Key to the Genus *Demodex* Owen.]—*Redia* **28** pp. 89–102, 1 pl., 1 fig., 11 refs. Florence, 1942.

Del Ponte (E.) & Heredia (R. L.). *Anopheles* (*Anopheles*) *holmbergi* **n. sp. de Misiones** (**Argentina**) (**Diptera Culicidae**). [*A. holmbergi*, sp. n., from Misiones, Argentina.]—*Rev. Soc. ent. argent.* **12** no. 5 pp. 382–386, 2 figs. Buenos Aires, 1945.

Descriptions are given of the adults of both sexes, the male terminalia and larval exuviae of *Anopheles* (*Anopheles*) *holmbergi*, sp. n., which was bred from larvae collected in 1944 at San Ignacio, in the Province of Misiones, Argentina. The adults resemble the descriptions of *A. fluminensis*, Root, but are differentiated by the male terminalia.

McCulloch (R. N.). **The Adaptation of military Scrub Typhus Mite Control to Civilian Needs.**—*Med. J. Aust.* 1947 **1** no. 15 pp. 449–452, 2 figs., 7 refs. Sydney, 1947.

American workers having discovered the value of benzene hexachloride in killing Trombiculid mites in their breeding areas at a very low dosage without harming vegetation [*R.A.E.*, B **36** 7], experiments on its effectiveness against *Acomatacarus australiensis*, Hirst, the cause of grass itch in Sydney [*R.A.E.*, B **35** 96], were made in the western suburbs of the town. Larvae of *A. australiensis*, like those of other Trombiculids, usually remain on or in the soil, from which they crawl on to hosts, but they can also leave the ground, at least in damp weather, and congregate, presumably awaiting hosts, in such situations as the tops of fence posts. Attacks on man are distributed over the clothed body, but the larvae appear incapable of attaching themselves successfully to unclothed human skin. Irritation usually begins 10–18 hours after attachment and lasts several days.

With a view to choosing sites for the experiments, several gardens were inspected at intervals of 7–10 days from 16th September, 1946. The mites were first seen on 11th November and were plentiful by 27th, particularly in one garden which was selected for the tests. For detailed surveys, oblongs (7×4 ins.) of black cotton cloth on wire frames were exposed flat on the ground for 2–4 minutes. The larvae are known to run on to almost any new object placed among them. On the most heavily infested patches of ground, 30–50 mites were taken per cloth after exposure for two minutes on bare soil. Direct sunlight greatly reduced mite activity on the hot surface. Seven plots, 6 or 12 sq. yards in area, were marked out for the experiments. Each included 4–6 patches known to be heavily infested. Five plots were dusted fairly evenly on 9th December with 1 or 1½ oz. per 6 sq. yards of a dust containing 14 per cent. crude benzene hexachloride, and therefore about 1·9 per cent. γ isomer, in an inert carrier, this rate being equivalent to about 1 and 1½ lb. γ isomer per acre. Mite populations were immediately reduced. Data are given for a control plot and the treated plot on which results were least good. The reduction throughout the 17 days of observations was in the order of 95–99 per cent. This plot had received the higher dosage. The fact that kill was not complete was thought to be due to the continued hatching of eggs in the soil. It is recommended that garden beds and lawns should be dusted at the rate of 1 lb. γ isomer per acre when the mite becomes obvious in spring and the treatment repeated as required, probably at intervals of 2–4 weeks. If there is only one generation in the season, 2–3 dustings may give complete control.

The methods and value of treating clothes with dibutyl or dimethyl phthalate against Trombiculids [*cf.* **34** 143, 169; **35** 96, etc.] is discussed, and reference is made to American work with benzyl benzoate and benzil for this purpose [**35** 191]. Treatment of clothing has proved effective against *A. australiensis*, but is primarily recommended against species that occur where the use of benzene hexachloride is impracticable.

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LATTA (R.), RICHARDSON (H. H.) & KINDLER (J. B.). **Methyl Bromide as a delousing Agent.**—*Circ. U.S. Dep. Agric.* no. 745, 40 pp., 26 figs., 2 refs. Washington, D.C., 1946.

Acrylonitrile, calcium cyanide, ethylene dichloride, chlorpicrin, 1,1-dichlor-1-nitroethane (Ethide), methyl bromide and a mixture of 75 per cent. ethylene oxide and 25 per cent. ethylene dichloride (Oxyfume) were tested in Maryland in preliminary studies designed to find a fumigant that would free clothing from *Pediculus humanus humanus*, L. (*P. h. corporis*, Deg.). As early tests had shown that the egg was the stage most resistant to fumigants [*cf. R.A.E.*, B **32** 135], practically all tests were made with eggs. Small pieces of cloth with eggs attached were fumigated and then aired and transferred to a moist, warm environment (90°F. and relative humidity near saturation). Eggs of all ages were used. Chlorpicrin, calcium cyanide and methyl bromide were tested in a water-sealed drum-type fumigator with a capacity of 7·5 cu. ft. and fan circulation. The exposure time was 30 minutes. All appeared effective in the absence of clothing, but only methyl bromide gave control when clothing was introduced, and this only with dosages of 4 lb. or more per 1,000 cu. ft. When the seven fumigants were tested with exposures varying from ½ to 17½ hours in gastight bags having a capacity of about 5 cu. ft., chlorpicrin and methyl bromide gave the best results. These two were compared in a metal-lined vault with a capacity of 107 cu. ft. Clothing was present at the rate of 2–3 lb. per cu. ft., and the exposure period was usually 30 minutes. Circulation was maintained by a small fan. Methyl bromide at 6 lb. per 1,000 cu. ft. gave complete kill, but chlorpicrin was not effective in any test, even when the exposure period was increased to one hour. Methyl bromide was therefore chosen for further experiments. In addition to being the most effective fumigant tried, its advantages were that it did not stain clothing, left no odour, had a low boiling point, was not inflammable and was apparently harmless to articles, especially those made of plastics, that might be included in a soldier's equipment. The disadvantages of the other fumigants are given.

In the subsequent tests of methyl bromide, fumigation was carried out in vaults, individual bags or pits. The vault (plywood cabinet) is described [**32** 20], and an account is given of experiments made in it. As a result of them, half-an-hour's exposure to methyl bromide at 9 or 12 lb. per 1,000 cu. ft. space (three or four one-pound cans per 330-cu. ft. vault) when the temperature of the clothing is above or below 60°F. was recommended [*cf.* next abstract]. Damp clothing was successfully fumigated (all eggs being killed in all tests with 8 lb. per 1,000 cu. ft.), but not clothing so wet that water could be wrung from it by hand.

A description is given of the bags used for the fumigation of one soldier's clothing and equipment [**32** 20], together with accounts of comparative tests of various types of closure and experiments on the best dimensions for the bag, the best position for it and the best position for the ampule. Most satisfactory results were obtained when the bag was laid on its side, or, failing this, when the ampule was near the top. A pocket was therefore made near the top of each bag to hold the ampule. Providing that one or other of these precautions was taken, varying the dimensions of the bags within small limits (width 25 or 28 ins. with a length of 50 ins.) did not matter. Results are also given of tests made with bags of various specified materials. All were practically as efficient as those coated with ethyl cellulose or neoprene. In the first tests, the minimum dosages effective with an exposure of six hours were 1 cc. per bag at 65–70°F., 4 cc. at 36° and 5 cc. at 25°. A dosage of 12 cc. allowed a few eggs to hatch in three of 16 tests made with an exposure of half-an-hour. A standard dosage of 20 cc. per bag was then fixed and tests made to determine exposures. At 45°F. and above, 30 minutes was apparently sufficient, but at 36°F., 1¾ hours

showed a few surviving eggs in three of four tests, although shorter exposures often resulted in complete mortality. A few eggs survived in three out of eight tests at 25°F. in which the exposure was 1¾ hours, but mortality was complete with all exposures of one hour or more at 10°F. Slight survival occurred in two out of seven tests in which exposure was for 2¼ hours at 0°F. Active lice were readily killed with exposures of ¾ hour at 50° and above, 1¼ hours at 41°, 1¾ hours at 36° and 25° and 2¼ hours at 0°F. Eggs were little affected by exposure to low temperatures alone when these were above 0°F., but were killed by exposure for 8–16 hours at 0°F., or for 2–3 hours to −10°. The minimum exposures required to give complete mortality of active lice appeared to be about 4–8 hours at 10°F., 1–1½ hours at 0° and 20–50 minutes at −10°. The exposures recommended for 20 cc. ampules were ¾ hour at 55°F. or above, 1¼ hours at 45 to 54°, 1¾ at 35 to 44° and 2¼ at −9 to 34°. At −10°F. and below, exposure for 2¼ hours to cold alone is recommended.

Pit fumigation of clothing in barracks bags [**33** 129] at dosages comparable with those used in the other methods was also found to be effective. It was carried out in individual pits holding one bag, trench pits holding two bags side by side, jug-shaped pits narrowed at the top and holding 4–21 bags and straight-walled pits holding 20–30 bags. When the bags had been placed in the pits and the opening covered, the methyl bromide was introduced into the smaller pits by dropping on to the bags ampules broken by crushing the tip with a pair of pliers held at arm's length beneath the cover, or into the larger ones by emptying it through a short rubber tube from one-pound cans opened with the same device as was used with the vaults. After the fumigant had been introduced, the cover was sealed with earth. Duck coated with ethyl cellulose, lightweight army raincoats, wrapping paper, newspaper, waterproof canvas tarpaulin and boards were tried as covering materials. The first two were the best and the last two the least satisfactory. On calm days, high mortality was obtained in small-mouthed pits without a cover, but a tight cover was necessary on windy days. A few eggs survived in all tests in the straight-walled pit, which had a large opening. Dosages of one ampule for one bag, two for two bags, three for four, four for five, and eight for ten were satisfactory. A one-pound can was sufficient for 12–21 bags, and the same amount was used in the large pits for 20–30 bags.

Methyl bromide could be rapidly removed from clothing by airing, and no dermatitis occurred in experiments in which clothing was worn without being aired, but the accumulation of fumes from large quantities of treated clothing in closed buildings necessitated special ventilation.

Data are given on the use of methyl-bromide fumigation by the armed forces in the field [**32** 195] and at permanent delousing stations at ports of debarkation, where permanent vaults sometimes of concrete with steel doors have been installed.

STONE (P. C.) & LAHUE (D. W.). **Rapid Vacuum Fumigation of the Body Louse with Methyl Bromide.**—*J. econ. Ent.* **39** no. 5 pp. 581–588, 1 fig. Menasha, Wis., 1946.

An account is given of experiments on vacuum fumigation with methyl bromide against the body louse [*Pediculus humanus humanus*, L.]. Exposure for 30 minutes at atmospheric pressure to 1 lb. methyl bromide per 100 cu. ft. was the recommended treatment for clothing of prisoners of war and infested American personnel arriving in the United States, provided that the temperature of the clothing was over 70°F. [*cf.* preceding abstract]. By changing to vacuum fumigation, it was possible to increase the number of men dealt with in an hour from 150 [*R.A.E.*, B **32** 195] to 550. During the summer of 1943, six cylindrical submarine-net buoys each 12 ft. long and with a capacity of 300 cu. ft.,

were adapted as vacuum fumigation chambers by fitting a hinged door with a rubber gasket to one end and cutting away the bulkhead in the centre. Concrete was poured in to a depth of 13 ins. to form a floor, leaving an air capacity of 261 cu. ft. Each chamber was equipped with a sheet steel ramp, a 2-inch breaker valve, a 6-inch ventilator shaft with centrifugal exhaust fan, electrical connections and light, two 8-inch circulating fans, 49 ft. of hot water heating pipes, an immersion thermometer, a vacuum gauge, a gas introduction apparatus and two vacuum exhaust openings measuring 2·5 ins. The chambers were insulated on the outside with a 2-inch layer of canvas-covered asbestos. One chamber accommodated three slatted fumigation carts, each of which held the clothing of 20 men packed in individual numbered bags. The vacuum pump was driven by a 60-horse-power electric motor.

About 100 engorged nymphal and adult lice and 200 eggs laid on each of the previous six days were used in each experiment. The seven groups were wrapped separately in six thicknesses of cheesecloth and placed in perforated cardboard containers in the centre of 60 clean army blankets in one of the carts. The cart was placed in the chamber and the air was withdrawn until a vacuum of 28·5 inches of mercury was reached. In the experiments on a sustained vacuum, the measured dosage of gas was then introduced, the resulting slightly reduced vacuum was maintained for the exposure period and then broken, and the gas was removed from the clothing by three successive " air wash " vacuums of 25 inches. The exhaust fan was then operated for a minute with the breaker valve open to draw air currents to the rear of the chamber before the door was opened. In experiments with a dissipated vacuum, the procedure was the same except that, following the introduction of the methyl bromide, the vacuum was reduced to 5 ins. with outside air. The dosages used were 0·5, 0·75, 1, 1·125, 1·25 and 1·5 lb. methyl bromide per 100 cu. ft. and the time of exposure varied from 5 to 35 minutes with intervals of 5 minutes.

The metabolism of the lice and the effectiveness of the gas were influenced by the temperatures of the blankets, outside air and chambers. All lice were very active immediately after fumigation. With adequate dosage and exposure, they then became paralysed and did not feed, pair or oviposit before death. If the amount of gas or time of exposure was inadequate although eventually fatal, a small percentage of the lice survived for many hours more and some fed, paired and oviposited before death. The most resistant eggs were less resistant to the gas under most conditions than the active stages. Eggs of the same age were uniformly resistant, but eggs one and six days old were much more susceptible than those of intermediate ages, the greatest resistance being shown by eggs two and three days old.

Tables of results are given, based on 148 of the 311 experiments made. The excluded experiments substantiated them. At temperatures above 24°C. [75·2°F.], both sustained and dissipated vacuums were effective, and exposure for 15 minutes to 1 lb. methyl bromide per 100 cu. ft. was adequate. When the lice were chilled at 6°C. [42·8°F.] for 24 hours and then fumigated under cold-weather conditions (blanket temperatures between 0 and 10°C. [32 and 50°F.], temperatures in the chambers between 24 and 31°C. [75·2 and 87·8°F.] and temperatures of the outside air used to dissipate the vacuum between 1 and 7°C. [33·8 and 44·6°F.]), with exposures varying from 20 to 35 minutes, a dissipated vacuum was less effective than a sustained vacuum with the shorter exposure periods and lower dosages. With either procedure, the time of exposure had to be increased to at least 35 minutes and the dosage to 1·5 lb. when the clothing was chilled below 10°C. Similarly, when lice incubated at 27–29°C. [80·6–84·2°F.] were fumigated for 20–35 minutes under the same cold-weather conditions, a dissipated vacuum was generally less effective than a sustained vacuum at low dosages and with short exposure periods. With longer exposures and higher dosages, all eggs were killed by both procedures and there was little difference in the length of time between fumigation and the

death of the last louse. When incubated lice are found in chilled clothing, usually some lice are present that have been chilled for many hours, and a dosage of 1·5 lb. methyl bromide and exposure of 35 minutes are recommended.

In experiments carried out in similar chambers heated with a high pressure steam system, at chamber temperatures ranging from 25 to 64°C. [77-147·3°F.], exposure in a sustained vacuum for 10, 15 and 20 minutes to 0·5 lb. methyl bromide per 100 cu. ft. when the temperature of the blankets and the outside air was generally 23–32°C. [73·4–89·6°F.] indicated that the activity of the gas was greatly increased by higher chamber temperatures and a higher kill of the eggs and a quicker kill of the active stages were effected. At low dosages and with short exposures, the period between fumigation and death of the last louse was inconsistent, because lice in the process of moulting may extend this period by several hours or even survive.

LOEFFLER (E. S.) & HOSKINS (W. M.). **Toxicity and Repellency of certain organic Compounds to Larvae of** *Lucilia sericata*.—*J. econ. Ent.* **39** no. 5 pp. 589–597, 13 refs. Menasha, Wis., 1946.

During a systematic study of repellent materials to protect animals from adult blowflies, the toxic or repellent action of the materials to larvae of *Lucilia sericata*, Mg., was investigated. Larvicidal action in fly repellents would reinforce their prophylactic value and allow complete treatment of an infested wound by one application. A larvicide should repel the maggots from the wound and then kill them, as, if it kills them in the wound, they have to be removed to avoid sepsis and this usually aggravates the wound and increases the possibility of restrike. Further, it should first penetrate deep into the wound through both oily and aqueous phases to reach the larvae there. A new laboratory test method for systematic evaluation of larvicides was developed and is described. It makes it possible to assess ability first to repel and then to kill. An infested wound was simulated by allowing larvae to form sinuses in a medium of casein, yeast, agar and butter [*R.A.E.*, A **29** 407] covered by raw wool in a dish. After the contents of the dish had been sprayed with the material to be tested, it was placed in a jar containing unsprayed agar food medium so that larvae could migrate. Inspections for repellency and toxicity were made at intervals of 2 and 12 hours. The larvae leaving the sprayed dish gave a measure of the repellency of the spray, except in cases of immediate toxic effect. The larvae dying in the dish within two hours gave a measure of rapid toxicity, which would largely prevent escape of the larvae even if they were repelled. The larvae dying within 12 hours included also those that died more slowly and were prevented from migrating by the onset of toxic effects. Larvae dead after migrating from the dish indicated delayed mortality.

The sprays used in the authors' experiments usually contained 5 per cent. by volume of the liquid to be tested in cellosolve (ethylene glycol monoethyl ether), which is itself highly repellent to third-instar larvae and somewhat less so to fourth-instar larvae. The results are discussed at some length. The following is based on the authors' summary of them. Diphenylamine, butyl carbitol chloracetate and epichlorhydrin were the most effective repellent larvicides. The results also indicated that in the hydroxy alkyl ether series, toxicity increased in the order alcohol, acetate, thiocyanate and chloracetate. None of the alkyl sulphides or disulphides was toxic. Replacement of the alkyl group by the aryl group did not increase toxicity. Thiodiphenylamine [phenothiazine] was more toxic than any related compounds, but diphenylamine gave a much higher delayed mortality, though the total mortality was slightly lower. Several halogenated compounds, including DDT, the γ isomer of benzene hexachloride and the less known epichlorhydrin and butyl carbitol chloracetate, were highly toxic.

Madden (A. H.), Schroeder (H. O.), Knipling (E. F.) & Lindquist (A. W.). **A modified Aerosol Formula for Use against Mosquitoes and Houseflies.** —*J. econ. Ent.* **39** no. 5 pp. 620–623, 5 refs. Menasha, Wis., 1946.

It has been found that a reduction in the content of pyrethrum extract in aerosols can be offset by an increase in the content of sesame oil [*R.A.E.*, B **35** 127], that the addition of 0·2 per cent. pyrethrins to the basic DDT aerosol formula (5 per cent. DDT and 10 per cent. cyclohexanone) gives an aerosol highly effective against both flies and mosquitos [*cf.* **34** 133] and that vegetable and motor oils are as effective as sesame oil in both pyrethrum and DDT aerosols. This paper contains an account of a continuation of these studies in which further tests were made against *Anopheles quadrimaculatus*, Say, and *Musca domestica*, L. The insects, confined in small gauze cages, were carried about an aerosol-filled room, the mosquitos for one minute and the flies for five minutes, or occasionally two, and then transferred to clean cages. Freon-12 (dichlordifluoromethane) was the carrier gas.

Reducing the content of cyclohexanone in a 5 per cent. DDT aerosol to 6 per cent. and adding 5 per cent. fatty material (propylene glycol monooleate, propylene glycol monolaurate or oleic acid) did not increase effectiveness or did not do so enough to warrant further consideration of these materials, since there was no marked improvement in knock-down. The addition of 2·5 per cent. Vatsol OT (dioctyl sodium sulphosuccinate) as a wetting agent to the basic DDT formula increased kill of mosquitos but not of house-flies. When Nopco 1216 (sulphonated sperm oil) was used, the mortality of both insects was much less than with the basic formula. Motor oil was found to be just as effective as sesame oil in the pyrethrum aerosol formula containing 0·4 per cent. pyrethrins and 8 per cent. oil. At 5 per cent., it increased the effectiveness of the DDT formula, and its viscosity had no bearing on the results. Kerosene definitely reduced the effectiveness of the pyrethrum aerosol against mosquitos. A formula containing 3 per cent. DDT, 5 per cent. cyclohexanone, 5 per cent. motor oil and 0·3 per cent. pyrethrins was found to be relatively stable at low temperatures and to have the desirable dual effectiveness against mosquitos and house-flies. It avoids the risk of damage to plastics that may result from the careless use of aerosol solutions containing 10 per cent. cyclohexanone.

Travis (B. V.), Morton (F. A.) & Cochran (J. H.). **Insect Repellents used as Skin Treatments by the Armed Forces.**—*J. econ. Ent.* **39** no. 5 pp. 627–630, 3 refs. Menasha, Wis., 1946.

An account is given of experiments carried out in Florida in 1942–43 establishing the effectiveness of dimethyl phthalate, Rutgers 612 (2-ethyl-1,3-hexanediol) and Indalone (*n*-butyl mesityl oxide oxalate) and a mixture of them in the proportion 6 : 2 : 2 as repellents against mosquitos [*cf. R.A.E.*, B **34** 10 ; **35** 51–52]. All these repellents have been used by military groups, but the mixture is recommended as it gives protection against a greater range of species than any individual one. Indalone and the mixture also give protection against *Stomoxys calcitrans*, L., for an average of three hours, and all the materials protected against *Cnephia* (*Eusimulium*) *pecuarum*, Riley, in Mississippi for 6–10 hours when used on man and on domestic stock at about 150 ml. per animal [*cf.* **35** 52]. Each of the three individual repellents prevented biting by moderate populations of *Culicoides* spp. for at least four hours. Granett's method of testing [**29** 65] and paired tests [**34** 25] were used. All the repellents are solvents of paints and many plastics, have an oily feeling on the skin, irritate mucous membranes, are easily wiped off, and give very little protection except on surfaces actually covered.

Rice (R. I.), Johnstone (H. F.) & Kearns (C. W.). **A simple Exhaust Aerosol or Spray Generator for dispersing Insecticide Solutions.**—*J. econ. Ent.* **39** no. 5 pp. 652–658, 4 figs., 2 refs. Menasha, Wis., 1946.

The following is based mainly on the authors' summary. The need for simple, efficient equipment to disperse insecticides for controlling mosquitos during the war led to the development of a generator, mounted on a jeep, in which the liquid is injected into the high velocity exhaust gases at the throat of a venturi so that the shearing forces on it effect atomisation. It is released as a spray or aerosol, the droplet size decreasing as the gas velocity is increased and the rate of liquid flow decreased. The equipment consists of an insecticide reservoir, a control valve with indicating dial, a length of flexible hose, a simple clamp cutout, and a sheet-metal venturi nozzle, which is clamped on the exhaust pipe of the engine after the muffler has been removed. The venturi is mounted on the flexible tubing extension, which can be pointed at any required angle. Insecticide solutions and emulsions made up with solvents having either high or low boiling points were successfully applied with the equipment, the principal uses of which have been for the control of flies and mosquitos with solutions of DDT around places where people gather in large numbers, drainage ditches and swamps, and in dairies, barracks and other large buildings. Indoors, the device was adjusted to produce drops varying from 5 to 25 microns in diameter. The dosage required under such conditions was about 100 mg. DDT per 1,000 cu. ft.

A detailed description is given of the equipment, its installation and the method of operating it on a jeep. A similar device installed on the exhaust of light aircraft is also described. Suggestions are made on the use of these devices for dispersing insecticides for the control of mosquito larvae and agricultural pests. Coarser sprays were generally more satisfactory than aerosols against mosquito larvae.

Yust (H. R.). **Airplane Spraying Apparatus for Mosquito Control.**—*J. econ. Ent.* **39** no. 5 p. 659, 1 fig. Menasha, Wis., 1946.

The spray rod and dispersing device of an apparatus for applying solutions of DDT in oil from small aircraft for the control of mosquito larvae and adults are described. They give a deposit of 100 or more droplets per sq. in. over a width of 100 ft. with an application rate of 2 U.S. quarts per acre, and the control effected is excellent. The installation also includes an insecticide tank, pump, shut-off valve, connecting hose, and electrical facilities and connection for operating the pump. The solution is discharged under a pressure of about 50 lb. per sq. in. through a $\frac{3}{4}$ in. pipe 10 ft. long. This spray rod is attached 8 ins. below the fuselage directly behind the landing gear and extends on either side of the cockpit. It is secured in the middle by two brackets attached to the fuselage and at the outer ends by struts attached to the wing supports. The insecticide is emitted from five holes 0·07 in. in diameter and 9 ins. apart on both ends of the pipe. The holes are directly opposite the leading surface of the pipe during flight. Both ends of the pipe contain threaded caps to facilitate removal of particles that may clog the holes. The dispersing device consists of two strips of sheet metal, one fixed behind each row of holes in the spray rod, shaped to act as a wind scoop, breaker strip and " drag " bar. Each strip is 42 ins. long and 2 ins. wide and is shaped by bending back the bottom half inch along its length through an angle of 45° to form the drag bar, and moulding the remainder forwards into an arc. The strip is bolted to the pipe so that the lower part of the arc is 0·25 in. behind the holes and serves as the breaker strip, while the top is 0·25 in. above the top of the pipe and serves as the wind scoop. When the streams of insecticide strike the breaker strip, some of the fluid is broken up into small particles, which the air scoop forces into the propeller wash. The remainder of the fluid is spread laterally over the half-inch

" drag " bar by the air pressure on the flat surface and is dispersed in very small droplets as it leaves the trailing edge. The result is a continuous 42-inch spray on the outer ends of the pipe. Additional dispersion occurs in the air slip. The most thorough coverage and best control were obtained by applying 5 per cent. DDT in fuel oil at 1 U.S. quart per acre in one run and making a second trip to double the rate of application.

EADS (R. B.). **Control of the Sticktight Flea on Chickens.**—*J. econ. Ent.* **39** no. 5 pp. 659–660, 1 ref. Menasha, Wis., 1946.

Field tests on the control of *Echidnophaga gallinacea*, Westw., on fowls with 10 per cent. DDT dust were made in a poultry-farming area in south-eastern Texas in 1946. On one typical farm, the 175 hens and the one hen house were so heavily infested with *E. gallinacea* that the removal of 200 fleas from a typically infested hen did not materially affect the total on the bird. About two U.S. pints of the 10 per cent. dust were applied to the hen house, which measured 40 by 25 ft. Nests and roosts were liberally coated with a hand shaker, and the floor and walls were treated with a hand duster. No individuals of *E. gallinacea* were evident in the house on the next day and the infestation on the fowls seemed to be reduced. The hens were free of fleas within a week, and no reinfestation had appeared a month after dusting. There was no corresponding fall in flea populations on surrounding untreated farms.

CULPEPPER (G. H.). **Rearing Body Lice on Rabbits.**—*J. econ. Ent.* **39** no. 5 p. 660. Menasha, Wis., 1946.

A colony of *Pediculus humanus humanus*, L. (*P. h. corporis*, Deg.) has been maintained for four years in a laboratory at Orlando, Florida, with two feeds daily on man [*R.A.E.*, B **33** 161]. Recently, lice from this colony have been maintained successfully through six generations when fed twice daily on the shaved abdomen of a rabbit. Preliminary observations made on the third, fourth and fifth generations indicate that they live as long, reproduce as well, develop as rapidly and are about as resistant to insecticides as are those fed on man, though other workers who reared this louse for two generations on rabbits found that it did not thrive on them [**34** 1]. As the Orlando strain may, by four years of inbreeding, have become adapted to laboratory rearing, investigations will be made with new stocks of lice. Preliminary observations indicate that there is considerable variation among rabbits as suitable hosts.

ACREE jr. (F.), HAVILAND (E. E.) & HALLER (H. L.). **The Nature of the Venom of *Formica exsectoides*.**—*J. econ. Ent.* **39** no. 5 pp. 661–662, 5 refs. Menasha, Wis., 1946.

A chemical study of the venom of *Formica exsectoides*, Forel [*cf. R.A.E.*, B **35** 27] showed that the only volatile acid component was formic acid and that it occurred to the extent of 0·68 mg. per ant.

JONES (H. A.), INCHO (H. H.) & DEONIER (C. C.). **Comparative Toxicity of p,p′- and o,p′-DDT to Larvae of *Anopheles quadrimaculatus*.**—*J. econ. Ent.* **39** no. 5 pp. 672–673, 1 fig., 1 ref. Menasha, Wis., 1946.

The major impurity in technical DDT is the o,p′ isomer [*R.A.E.*, B **34** 191], which is less toxic to fourth-instar larvae of *Anopheles quadrimaculatus*, Say, than the p,p′ compound. To determine the reduction in the effectiveness of DDT with increasing proportions of the o,p′ isomer, fourth-instar larvae of this Anopheline were placed in water suspensions from acetone solutions of the pure

isomers and mixtures of them. When the concentration of the suspension was 0·005 parts per million, the average percentages of the larvae dead in 48 hours were 3·5 for the o,p′ isomer, 11, 37·2 and 41·8 for mixtures containing 75, 50 and 25 per cent. of this isomer by weight, and 55·3 for the p,p′ isomer. Observed mortalities after 24 and 48 hours for this and other concentrations of the five suspensions are shown in a table, and the concentrations calculated to give 50 per cent. mortality in 48 hours are plotted in a graph. These concentrations are 0·0263 and 0·0045 p.p.m. for the pure o,p′ and p,p′ isomers, indicating that the latter is about six times as toxic as the former.

BLAIR (D. M.). **Baited Fly Traps.**—*Rhod. agric. J.* **42** no. 6 pp. 488-492, 1 fldg. pl. ; also as *Bull. Minist. Agric.* [*S. Rhod.*] no. 1328, 6 pp., 1 fldg. pl. Salisbury, S. Rhod., 1945.

As many as 4,500 flies an hour were caught in the Western Desert of Egypt in the summer of 1941 in a new type of trap, the feature of which is that the bait is in relative darkness and flies that have fed are attracted by the light above into a trapping cage with a cone entrance. The trap is effective only in the open in good light. It appeared to have an effective attraction radius of 300 yards and should not be placed within 50 yards of dwellings or dairies. Illustrations are given of the original model (Bruton trap), in which the cage was a wire gauze cylinder at least 20 inches high fixed to a wire frame and covered on the top with hessian, and of a modified one (the standard M.E.F. trap), in which the cage has a framework made from a petrol tin and is therefore stronger. They are equally effective. In both, the cage containing the cone stands on a landing platform over a bait tin. The bait tin is a 4-gal. petrol tin with the lid removed except for a rim that is turned down to an angle of 45° to prevent the escape of larvae that develop in the bait. The bait should be bulky and moist and nearly half fill the tin. A proportion of meat or fish should be included unless the smell is likely to cause a nuisance, when fruit should be used. The landing platform is of wood and has a central aperture not exceeding six inches in diameter. The cage of the standard M.E.F. trap has gauze panels fitted to the metal framework with fly-tight joints, and the bottom edge of the frame is turned up except at the corners to provide a slit $\frac{3}{16}$ in. high for the flies to enter. The lid is also of gauze on a frame and must fit well. The gauze cone, which is 6 ins. high, can be crimped into the upturned bottom rim of the tin, but its base should be soldered into the corners where the edge of the tin remains to form the feet. The aperture at the apex of the cone should not exceed $\frac{1}{4}$ in. in diameter. Rust scales on the gauze should be removed periodically as they reduce light. A standard trap filled with dead flies to the apex of the cone contains about 80,000 flies. At the end of a week, the bait should be replaced and the old bait and the trapped flies burned. Any flies that have not died may be killed by placing the tin in the smoke of a fire or passing it quickly through a flame.

Observations on the performance of the trap in Palestine, the Western Desert and Southern Rhodesia are given. The largest weekly catch in Palestine was 54,447 flies. In some localities in the Western Desert, 80,000 flies could be taken in two days. Catches were negiligible in the winter in a residential area of Salisbury, but after late October, the weekly catch averaged 30,000 flies, of which 80 per cent. belonged to the *Musca* group.

CHORLEY (J. K.). **Tsetse Fly Operations. Short Survey of the Operations by Districts for the Year ending December, 1944.**—*Rhod. agric. J.* **42** no. 6 pp. 493–499 ; also as *Bull. Minist. Agric.* [*S. Rhod.*] no. 1331, 8 pp. Salisbury, S. Rhod., 1945.

Investigations during 1944 and Portuguese records indicated that the area occupied by *Glossina morsitans*, Westw., in Portuguese East Africa south of the

Zambesi and east of the Ruenya river had been extending rapidly over a number of years. Heavy loss of stock had occurred, and motor traffic had probably been responsible for the carriage of occasional flies to the border and for two cases of trypanosomiasis in cattle that were reported near it in Southern Rhodesia early in the year. Further spread of the fly westward into Southern Rhodesia is considered almost inevitable, but may be retarded by the comparative scarcity of large game. In the Chipinga area of the eastern border [Melsetter District], the incidence of trypanosomiasis in cattle decreased and fewer farms were involved [*cf. R.A.E.*, B **32** 23; **34** 15]. The border clearing was widened in parts and maintained by cutting back and burning. In addition to four examples of *G. brevipalpis*, Newst., and nine of *G. pallidipes*, Aust., one male and one female of *G. morsitans* were taken on the Rhodesian side of the border. This species had not previously been recorded inside the Colony in this area. Seven examples of *G. brevipalpis*, 55 of *G. pallidipes* and nine of *G. morsitans* were taken on the Portuguese side. A light but permanent infestation of *G. morsitans* is established on the east bank of the Sabi river where it enters Portuguese East Africa [*cf.* **34** 15], and one tsetse was taken and cases of trypanosomiasis of stock occurred on the west bank. South of the Sabi in Portuguese East Africa, there are reports of fly spreading towards the border and cases of trypanosomiasis occurring within 20 miles. In the northern districts, satisfactory progress had been made in all areas. The situation existing in individual districts and incidental control measures taken are briefly recorded.

DE FIGUEREDO (A.) & SIMÕES BARBOSA (F. A.). **A propósito do hiperparasitismo de** *Pseudolynchia maura*. [On the Hyperparasitism of *P. canariensis*.]—*An. Soc. Biol. Pernambuco* **5** no. 1 pp. 15–16, 2 pls., 7 refs. Recife, 1944. (With a Summary in English.)

A description is given of the ovigerous female and the egg of *Myialges pseudolinchiae*, sp. n., a Sarcoptoid mite that was found in large numbers parasitising adults of *Pseudolynchia canariensis*, Macq. (*maura*, Big.) taken on domestic pigeons in Recife, Brazil. Characters are given distinguishing *M. pseudolinchiae* from *M. anchora*, Trouess., which parasitises the same Hippoboscid elsewhere.

DE LUCENA (D. T.). **O** *Anopheles* (*Nyssorhynchus*) *tarsimaculatus* **Goeldi, 1905 : sua morphologia no nordeste brasileiro.** [The Morphology of *A. aquasalis*, Curry, in north-eastern Brazil.]—*An. Soc. Biol. Pernambuco* **5** no. 1 pp. 7–13, 6 pls., 1 graph, 4 refs. Recife, 1944. **Esbôço ecológico do** *Anopheles* (*N.*) *tarsimaculatus* **Goeldi, 1905 no nordeste brasileiro.** [An Outline of the Ecology of *A. aquasalis* in north-eastern Brazil.]—*Op. cit.* **6** no. 1 pp. 3–40, 6 pls., 29 refs. 1946. (With Summaries in English.)

In the first of these papers on *Anopheles aquasalis*, Curry, for which the author uses the name *A. tarsimaculatus*, Goeldi [*cf. R.A.E.*, B **36** 3], detailed descriptions are given of the eggs, larvae and adults of both sexes of this Anopheline from material taken in the States of Alagoas, Pernambuco, Paraíba and Rio Grande do Norte, in north-eastern Brazil, where its distribution is closely related to that of epidemic malaria.

In the second paper its distribution in the Neotropical region is reviewed, with special reference to Brazil, and a list is given of the localities in the four north-eastern States in which breeding places were found. Its distribution is also shown on maps. It occurs chiefly in the coastal areas and has been thought to be restricted to them, owing to its habit of breeding in salt water, but there are extensive areas of salt lands stretching in from the coast, and larvae were found over 70 miles inland in Paraíba and nearly 160 miles inland in

Pernambuco. The climate and vegetation of the four types of country in these two States are described, and their distribution and that of *A. aquasalis* shown on maps. The Anopheline occurred chiefly in coastal and pastureland areas, but the larvae were restricted to water containing some proportion of chlorides. In the coastal areas, they were usually found in lagoons or backwaters, but inland they developed in ditches, pools or the overflow from rivers, the water being brackish because of the characteristic heavy chloride content of the soil in the areas concerned. The history and geology of the salt-bearing region is discussed ; the author considers *A. aquasalis* to be native to it and shows on a map the probable full extent of its inland range.

Analyses of water from over 70 permanent breeding places showed that the content of chlorides in them ranged from 0·117 to 33·345 gm. per litre on the coast and from 5·733 to 29·835 gm. per litre inland. In some places, where conditions were suitable, larvae of *A. albitarsis*, Arrib., or *A. argyritarsis*, R.-D., were also present. There were considerable variations in chloride content at different times ; on the coast, where the breeding places were fed by rivers and the sea, the salt content varied with the tides, while inland, the concentration was greater in summer than winter, owing to evaporation. The immature stages of *A. aquasalis*, therefore, are apparently able to tolerate varying degrees of salinity, but when two lots of eggs laid by females taken in a district in which the water had a permanently high saline content were placed in tap-water and in water containing 0·9 per cent. sodium chloride, respectively, the second lot developed normally and gave rise to active larvae, while most of the first sank in the course of a day and all became swollen and lost their floats. The eggs of females taken at a place in which the water was generally less salt hatched in tap-water, but only a very small proportion of the larvae reached the fourth instar.

The adults, which are essentially domestic in habit, were often taken in houses well over a mile from their breeding places, and when these were close to dwellings, enormous numbers of females and some males were found on the walls. Tables are given showing the numbers of *A. aquasalis* and other Anophelines taken in houses at various places and times during 1942–45 in the preferred zones in Rio Grande do Norte, Paraíba and Pernambuco, and the numbers taken in each month of 1943 in Ibura, near the coast of Pernambuco. *A. aquasalis* represented 91·1 and 95·5 per cent., respectively, of all the Anophelines taken in houses during 1943 and 1944 in Ibura ; the lowest percentage obtained was 88·5, at a place in Paraíba some distance from a breeding place, and in many places it was the only species present. It was most numerous in January and February, whereas *A. albitarsis*, the next commonest species, was most numerous in October. The greatest numbers of *A. aquasalis* occurred in houses between 10 p.m. and 10 a.m., but some were present throughout the day ; the hourly averages for January–July 1943 in Ibura are shown in a table. A few females were attracted to animal baits, but their preference for human blood was strongly marked ; men were often attacked in the open air, and in buildings during the day.

Silva (W.). **Contribuição ao estudo da história da malária na cidade do Salvador—Bahia.** [A Contribution to the Study of the History of Malaria in the City of Salvador, Bahia.]—*Rev. med.-cirurg. Brasil* **53** no. 2–3 pp. 17–59, 5 graphs, 1 diagr., 56 refs. Rio de Janeiro, 1945.

The author outlines the history and geography of Salvador, the capital of the State of Bahia, Brazil, in which malaria has been endemic, and occasionally epidemic, since it was first built. In 1929, *Anopheles argyritarsis*, R.-D., *A. albitarsis*, Arrib., and *A. aquasalis*, Curry (*tarsimaculatus*, auct.) were found.

to be common in the city [*cf. R.A.E.*, B **18** 257]. In 1936 a malarial service was instituted, the work of which included the inspection of dwelling-houses, the collection and identification of mosquito larvae and adults, and the preparation of blood smears. Tables and graphs are given showing data obtained in 1937–41 on the incidence of *Plasmodium falciparum* and *P. vivax* in persons of different age-groups; on the death rate from malaria and other diseases; on meteorological conditions and on the distribution of Anopheline breeding places. The larvae most commonly found were those of *A. aquasalis*, *A. argyritarsis*, *A. albitarsis*, *Aëdes scapularis*, Rond., and *Anopheles triannulatus*, Neiva & Pinto (*bachmanni*, Petrocchi), in that order. Adults of the first three species and of other Anophelines were attracted to animal baits, but the only species taken in dwellings was *A. albitarsis*, and dissection of females of this species revealed sporozoites in the salivary glands and oöcysts on the stomach. The author concludes that well organised drainage and the regulation of streams are required to eliminate Anopheline breeding places, and shows in an appendix that the proportion of deaths due to malaria diminished as a result of the work done in 1939–41.

HACKETT (L. W.). **The Malaria of the Andean Region of South America.**—*Rev. Inst. Salub. Enferm. trop.* **6** no. 4 pp. 239–252, 13 refs. Mexico, D. F., 1945. (With a Summary in Spanish.)

This is a discussion, based on personal observations and the records (mainly unpublished) of local malaria services, of the distribution and ecology of *Anopheles pseudopunctipennis*, Theo., in the Andean region of South America, where it is the principal and usually the only vector of malaria over an important part of its range. It breeds characteristically in unshaded pools and shallows of clean fresh water containing green algae along the margins and in the beds of hill streams when their volume is decreasing [*cf. R.A.E.*, B **19** 8–9; **27** 12–13], and is thus adapted to mountainous regions with a long dry season. Its breeding is interrupted by the turbulence of the streams during the rains, when it probably survives in secondary breeding places at lower altitudes. Its southern distribution corresponds with that of endemic malaria, extending in normal years to 31°S. lat. in Argentina (Córdoba), where it is limited by cold, and 20°30′ S. lat. in Chile (Pica Valley), where strips of desert form a barrier. It has caused epidemics of malaria in northern Argentina in occasional years in which a mild winter is followed by a fairly dry summer, but the climate is not usually favourable enough, as the cold of the rather dry winters and the heavy rains of summer leave only two widely separated periods of two months each for extensive breeding. Some breeding is thought to continue throughout the year [**16** 145], and it has been observed in Argentina that larvae were not killed by intermittent periods of frost, but began slowly to grow when water temperatures reached 14°C. [57·2°F.]. However, in Bolivia and Peru, breeding begins explosively after the rains, suggesting that unfavourable seasons can be survived by the adults.

A. pseudopunctipennis reaches its greatest known altitude in the Cinti Valley of Bolivia, at over 8,500 ft., but the maximum varies in different valleys, according to the nature of the breeding places available, and also in the same valley in different years, so that it probably depends more on water temperature than on the barometric pressure. The highest points at which larvae have been found in Colombia, Ecuador, Peru, Bolivia, Chile and Argentina, with notes on the local malaria conditions, are shown in a table. Several other Anophelines occur together with this species over much of its range, but the incidence of malaria in most of the Andean region corresponds exactly with the sharply defined rise and fall of *A. pseudopunctipennis*. In Colombia, however, as in Central America, malaria transmission in upland regions falls sharply,

although *A. pseudopunctipennis* is common ; so that several forms or species may actually be grouped under this name [*cf.* next abstract], the one present in Colombia resembling that known as var. *franciscanus*, McCracken, in the southern United States [*cf.* **30** 154].

VARGAS (L.). **Consideraciones sobre el complejo del *Anopheles pseudopunctipennis*.** [Considerations on the *A. pseudopunctipennis* Complex.]—*Rev. Inst. Salub. Enferm. trop.* **6** no. 4 pp. 265–270, 1 fig., 14 refs. Mexico, D. F., 1945. (With a Summary in English.)

Notes are given on the distribution of the four varieties of *Anopheles pseudopunctipennis*, Theo., recognised by the author [*R.A.E.*, B **29** 173] and on the characters distinguishing the eggs of all and the larvae and adults of some of them. They are *typicus*, which was probably described from Grenada, West Indies, and not, as was previously thought, Grenada, Nicaragua, and is stated to occur in the United States, Mexico, Costa Rica, Panama, Venezuela and (probably) Argentina and Chile, *franciscanus*, McCracken, and *boydi*, Vargas, which occur in California [**28** 46], and *willardi*, Vargas, which occurs in Mexico and probably the south-western United States. The author disregards var. *levicastilloi*, Levi Castillo [**33** 156], which he considers to be insufficiently described, and var. *rivadeneirai*, Levi Castillo [**34** 164], which he classes as a *nomen nudum* [but *cf.* **34** 40]. Var. *typicus* is stated to be of importance in the transmission of malaria only when it is present in large numbers and at altitudes above 2,275 ft.

SERGENT (Ed.) & SERGENT (Et.). **Une simple et radicale " grande mesure antilarvaire " contre les anophèles : le colmatage.**—*Rev. Inst. Salub. Enferm. trop.* **6** no. 4 pp. 259–263, 1 fig. Mexico, D. F., 1945. (With a Summary in Spanish.)

The authors describe the methods used to reclaim the swamp of Ouled Mendil, in Algeria, which was an important Anopheline breeding place. The autumn floods that bring down soil and vegetable débris from the neighbouring hills were directed into it in such a way that the level of the land was gradually raised and the surface ultimately became dry and fit for cultivation. The process lasted from 1924 to 1934.

VARGAS (L.) & MARTÍNEZ PALACIOS (A.). **Descripción del huevo, larva y pupa de *Anopheles gabaldoni* Vargas, 1941.** [A Description of the Egg, Larva and Pupa of *A. gabaldoni*.]—*Rev. Inst. Salub. Enferm. trop.* **7** no. 1 pp. 19–27, 3 figs., 6 refs. Mexico, D. F., 1946. (With a Summary in English.)

The egg, the first- and fourth-instar larvae and the pupa of *Anopheles gabaldoni*, Vargas [*cf. R.A.E.*, B **30** 11] are described from examples reared in the laboratory from females taken in November–December 1945 in the State of Chiapas, Mexico [*cf.* **32** 14]. Larvae were observed there in shallow rainwater pools in the forest, shaded from the sun, in association with those of *A. punctimacula*, D. & K. First- and second-instar larvae died when exposed to direct sunlight. In the second half of September, following heavy rains, *A. gabaldoni* was more numerous in houses at night than *A. albimanus*, Wied., or *A. vestitipennis*, D. & K., but it had become scarce by mid-October, and in November–December, adults were taken only by using animal bait outside the village. They showed a marked preference for horse over man.

BUSTAMANTE (M. E.), VARELA (G.) & ORTIZ MARIOTTE (C.). **II. Estudios de fiebre manchada en Mexico. Fiebre manchada en La Laguna.** [Studies of Spotted Fever in Mexico. II. Spotted Fever in La Laguna.]—*Rev. Inst. Salub. Enferm. trop.* **7** no. 1 pp. 39–48, 1 fldg. table, 1 map, 2 graphs, 7 refs. Mexico, D. F., 1946. (With a Summary in English.)

In 1945, further investigations on spotted fever in Mexico [*cf. R.A.E.*, B **34** 100] were carried out in the district of La Laguna, on the border of

Coahuila and Durango. Ticks were collected from houses and from dogs, and suspensions of them injected intraperitoneally into guineapigs. Two batches of *Rhipicephalus sanguineus*, Latr., one from the walls and floor of a house and the other from a dog, proved infective ; both originated from houses in which mortality from a typhus-like fever had occurred. In cross-immunity tests, both strains were shown to be similar to the strain isolated in Sonora [*loc. cit.*]. Complement fixation tests with sera of persons who had recovered from fevers and of dogs were positive for spotted fever.

GABALDON (A.) & COVA-GARCÍA (P.). **Zoogeografía de los anofelinos en Venezuela : I. Los dos vectores principales.** [Zoogeography of Anophelines in Venezuela. I. The two principal Vectors.]—*Tijeret. sobre Malar.* **10** no. 1 pp. 19–32, 4 maps, 25 refs. Maracay, 1946.

The two principal vectors of malaria in Venezuela are *Anopheles albimanus*, Wied., and *A. darlingi*, Root. Both have in the past been misidentified, and early records of the distribution of the former are not always reliable. During 1936–45, the Division of Malariology carried out surveys [*cf. R.A.E.*, B **27** 43], and from the results of these, detailed lists are compiled of the localities, arranged by States, in which these two species were found. Their known distribution before and after the surveys is also shown on maps. *A. albimanus* is more or less restricted to the northern coast, while *A. darlingi* is more numerous inland [*cf.* **32** 230]. The former probably reached Venezuela by ship and along the coast from Central America, while the latter was probably introduced from the south.

A. triannulatus, Neiva & Pinto, has been found infected with oöcysts in nature in Venezuela, but is not considered an important vector of malaria, and *A. pseudopunctipennis*, Theo., and *A. albitarsis*, Arrib., are probably vectors in some districts.

MELVILLE (A. R.), WILSON (D. B.), GLASGOW (J. P.) & HOCKING (K. S.). **Malaria in Abyssinia.**—*E. Afr. med. J.* **22** no. 9 pp. 285–294, 1 map, 9 refs. Nairobi, 1945.

Malaria is widely but sporadically distributed in Abyssinia, occurring chiefly at elevations below 6,500 ft. It is endemic along the larger rivers and on the foothills of the escarpments bordering the Danakil Plain, but over most of the country, the rainfall in areas sufficiently low to be malarious will allow Anopheline vectors to breed only at certain seasons. An account is given in this paper of observations made between April 1941 and March 1942, when malaria surveys were carried out by a mobile section of the East African Army Medical Corps in over 50 localities.

Much of the time was spent in the Rift Valley area, which stretches north-east from Lake Rudolf to the Red Sea coast. Malaria endemicity increases as the level of the country falls from the high plateaux until a zone of moderate hyperendemicity is reached at an altitude of about 5,000–6,000 ft. Below this, the disease may be hyperendemic and intense owing to the neighbourhood of streams, rivers or lakes, or slight owing to low rainfall. At higher levels, it is largely seasonal. Local rainfall varies greatly, increasing rapidly as the country rises to east and west. Water conditions are also influenced by precipitation in the mountain masses on the sides of the valley. The torrents in which much of this water reaches the valley leave residual pools that provide breeding places for *Anopheles gambiae*, Giles, even when there is no local rain. Moreover, the larger rivers are subject to sudden changes in level as a result of the hill water, and seepage pools often appear in otherwise dry sandy river beds. Breeding at lake margins is sometimes precluded by salinity, and *A. gambiae* appears able to breed in these situations only when the edges are fairly flat and heavy rains produce flooding. *A. gambiae* was found throughout the area and was responsible for epidemic malaria where it was dependent on the rainy seasons and endemic malaria where it bred throughout the year. Of the 14

other species of *Anopheles* taken, *A. pharoensis*, Theo., and *A. dthali*, Patt., are thought to have the greatest potential importance. *A. pharoensis* was very common over wide areas and sometimes extremely abundant. It entered human dwellings freely and bit readily. No gland infections were found in the few females dissected. It breeds in seasonal swamps and vegetation at the edges of lakes. *A. dthali*, which occurs on the Red Sea littoral, bred in sunlit seepage pools in the beds of otherwise dry rivers in that part of Abyssinia lying between British and French Somaliland and was the only species found at one place reputed to be malarious.

Four localities were visited in the north-western area, which comprises mainly large tracts over 6,500 ft. high, normally too cold for malaria, with deep-cut valleys up which the disease penetrates. Though periodic epidemics of some consequence may occur in the high country, the general level of endemicity and severity of epidemics is less than in the Rift Valley, but malaria is present for much of the year in the great river valleys. The seasonal distribution of rainfall is much more even than in the Rift Valley. Mountain rains cause pools to form in small tributaries and at the sides of the large rivers, and some of the higher valleys contain swamps connected by clear running streams. *A. gambiae*, the main vector, transmits endemic malaria in the river valleys as well as epidemic malaria during rains. *A. funestus*, Giles, appeared in fair numbers in the swamp areas after the rain had ceased and the water level had fallen. It is almost certainly involved in transmission. Nine other species of *Anopheles* were found.

In the south-eastern area, malaria varies according to district. *A. gambiae* and six other species of *Anopheles* were taken. There is a massive mountain range from which the country slopes away to the low deserts of Somalia. At Neghalli (about 4,000 ft.), which is typical of a wide area in the south of the region, moderate local rainfall and pool-formation in small rivers make mosquito breeding possible for only a relatively short season, which is further limited by low temperature. At the lower altitudes to the east, *A. gambiae* can maintain endemic malaria as breeding facilities are greater because of fluctuating water levels in larger rivers dependent on mountain rains. In the low deserts near Somalia, conditions away from the rivers are mainly dry.

It is concluded that as *A. gambiae* is the principal vector of malaria in Abyssinia and its breeding there does not depend solely on local rainfall, the transmission season in places where pools in river beds result from rainfall at higher altitudes may cover the whole year, and hyperendemicity thus depends far more on the proximity of streams and rivers than it does in other parts of Africa. The tendency for malaria to be an epidemic disease away from the rivers is exaggerated by the influence of high altitude with resultant low temperatures. The effect of the generally short transmission season is that little immunity is acquired by man and severe attacks are likely to be experienced by people of all ages.

LYLE-STEWART (W.). **Sheep Maggots and DDT.**—*Agriculture* **53** no. 4 pp. 178–180. London, 1946.

Experiments to test the efficiency of DDT dips for the control of sheep blowflies under mountain or fell conditions were carried out on five neighbouring flocks of fell sheep in a heavily infested district of Cumberland. In this area it is customary to shear sheep and crutch and dip lambs early in July, and to dip all sheep, including the lambs, towards the end of August. In the first experiment, 712 lambs were immersed for 30 seconds in a DDT dip and 712 in ordinary commercial dips of farmers' individual choice. During the next six weeks, two strikes, both of an unusual nature, occurred on the lambs dipped in DDT and 14 on the other lambs. During the chief dippings in the third week of August, 2,296 sheep and 640 lambs were dipped in DDT and the same numbers in proprietary dips. Shepherds patrolled the fells until 18th October,

when observations ceased. Two sheep were struck in the DDT groups and there were 16 strikes in the other groups. One of the strikes on sheep treated with DDT was on the mouth and the other on the neck where the wool was soiled with matter from a discharging ear. The DDT concentrate used was M 42 [*R.A.E.*, B **35** 103], a liquid emulsion made up of 15 per cent. by weight DDT, 34·1 per cent. solvent naphtha, 6·3 per cent. oleic acid, 0·75 per cent. caustic soda, 1·8 per cent. Teepol X and 42·05 per cent. water. This was diluted in water (1 : 30) to give a bath containing 0·5 per cent. DDT. It was easily handled and mixed with water to give a creamy, non-particulate liquid that wetted the fleece well after contact for 15 seconds. There was no differential filtration of DDT from the dipping bath as dipping proceeded, but some flocculation occurred after three days. There was no evidence of scalding or burning. In one case where strike occurred, the larvae disappeared without treatment.

DDT in the form of M 42 emulsion also appeared to be very effective against *Melophagus ovinus*, L., killing the keds present and also fresh ones as they emerged. Later tests with a modified emulsion indicate that DDT forms an effective winter dip, keeping the wool in good condition and the fleece free from infestation.

Nicol (G.). **Control of the Sheep Ked. Field Trial with D.D.T.**—*J. Dep. Agric. Vict.* **45** pt. 5 pp. 211–212. Melbourne, 1947.

An account is given of an experiment in Victoria on the control of the sheep ked [*Melophagus ovinus*, L.] on a heavily-infested flock of sheep by dipping in a stable suspension of DDT prepared by melting a water-dispersible commercial sample and pouring it into water. The dipping tank was 12–13 ft. long, and about 10 seconds were allowed for each sheep to pass through. The sheep had been shorn a week before, but some had a fair length of wool and unshorn lambs were included in the trial. The dip contained 0·2 per cent. w/v DDT at the beginning of the experiment and 0·18 per cent. after 107 lambs and ewes had been put through it. After an addition of water and DDT, the DDT content was 0·12 per cent. It was 0·11 per cent. after 94 shorn sheep had passed through, the same after the passage of a further 64 lambs, and 0·06 per cent. two weeks after dipping was completed. Two weeks after dipping, there were a few viable pupae on shorn ewes but no living keds, and there was a fairly heavy concentration of viable pupae on the lambs, particularly in the neck region, and three recently emerged keds were found. At the second examination, 18 days after dipping, all shorn ewes examined were free from keds and pupae but viable pupae were still present on the lambs. Both living and dead keds were found within pupal casings. Lambs on which viable pupae had been found still bore a number of such pupae 25 days after dipping but no living keds. It would appear that the duration of effectiveness of the DDT was considerable and that the keds died soon after they emerged. There were no living keds in evidence on any of the sheep examined two months after dipping. There were still some pupae attached to the wool of the lambs, but the larvae in all those examined appeared to be dead. No objectionable matting of the wool occurred after dipping, and toxicity to the sheep was obviously low.

Papers noticed by Title only.

Bean (J. L.). **A preliminary List of the Mosquitoes of Maine (Culicidae Diptera)** [including the first record of *Anopheles walkeri*, Theo.].—*Canad. Ent.* **78** no. 2 pp. 25–28, 12 refs. Guelph, Ont., 1946.

Mönnig (H. O.). **Veterinary Helminthology and Entomology. The Diseases of domesticated Animals caused by Helminth and Arthropod Parasites.**—3rd (revd.) edn., 9½×6¼ ins., xviii+427 pp., 8 pls., 260 figs., refs. London, Baillière, Tindall & Cox, 1947. Price 31*s.* 6*d.* net. [*Cf. R.A.E.*, B **22** 183 ; **26** 208.]

MILLER (A. W.). **Report of the Chief of the Bureau of Animal Industry, Agricultural Research Administration, 19[44–]45.**—49 pp. Washington, D. C., U.S. Dep. Agric., 1945.

The campaign for the eradication of *Boophilus annulatus*, Say, by inspection and dipping of cattle, horses and mules, was continued in the southern United States in the year ended 30th June 1945 [*cf. R.A.E.*, B **33** 150]. In Porto Rico, where the tropical variety, *B. a. microplus*, Can. (*australis*, Fuller) is prevalent and it is necessary to treat sheep and goats on infested premises, eradication work had to be discontinued from February onwards on the eastern two-thirds of the island. As a result, the ticks were able to spread to many herds previously freed. Stray or smuggled animals brought ticks into the lower Rio Grande Valley of Texas from Mexico on several occasions.

To test the practicability of controlling cattle grubs [*Hypoderma*] on an area basis, all the 2,295 cattle in ten herds on a range of 120 sq. miles in Colorado were treated once in January or February 1945 with a wash containing 12 oz. cubé powder (4·4–5 per cent. rotenone) and 3 oz. soap per U.S. gal. water. The wash was rubbed into the backs of the animals with a stiff brush. All the larvae present in the backs of about 10 per cent. of the cattle 6–10 days after treatment were extracted, and 98 per cent. were found to be dead. At a second extraction, 34–41 days after treatment, of larvae that had subsequently reached the backs of the same animals, 97 per cent. were dead, and at a third extraction, seven weeks after treatment, only a few of the small number removed were alive.

Lice on pigs were destroyed in three hours by a 0·1 per cent. suspension of DDT, but the animals became reinfested as eggs hatched. A 0·5 per cent. emulsion was more effective, but did not entirely prevent hatching. A 0·75 per cent. emulsion destroyed all lice and prevented reinfestation in a large herd kept under observation under farm conditions for 60 days. Sheep ticks [*Melophagus ovinus*, L.] in small flocks were destroyed by a 0·1 per cent. suspension of DDT, and repeated inspections revealed no reinfestation. However, a few survived 0·15 per cent. DDT in large-scale range tests. The fleece of the first part of the flock probably removed relatively large quantities of the DDT from the dip [*cf.* **34** 190].

A serious outbreak of equine encephalomyelitis occurred in horses in Cuba during the autumn of 1944 ; several samples of the virus were studied, and all were found to be of the eastern type.

SHANAHAN (G. J.). **Benzene Hexachloride (Gamma Isomer) as a Preventive of Poll Strike in Rams.**—*Agric. Gaz. N.S.W.* **58** pt. 6 p. 333. Sydney, 1947.

The benzene hexachloride used in these experiments against sheep blowflies in New South Wales contained 13 per cent. γ isomer and was applied as an emulsified xylene solution diluted to contain 0·75 per cent. benzene hexachloride. The heads of 30 Merino rams shorn in February 1946 were jetted in November with $\frac{1}{2}$ gal. emulsion per ram. No poll strikes were recorded in the next ten weeks on treated rams, but the heads of about 15 per cent. of untreated rams were struck. The heads of 75 Merino rams shorn in August 1946 were treated with $\frac{1}{3}$ gal. emulsion per ram in March 1947. The rams were free from poll strikes for eight weeks, while there were 50 strikes in a control group of 209. In applying the treatment, the wool on the poll area was saturated with the emulsion, which had no apparent adverse effect on either the rams or wool.

Prangos pabularia **Lindley and the Problems of its Use as a Drug Plant.** [*In Russian.*]—*Trans. Molotov Univ. Rostov-on-Don* **1** *Wks biol. Fac.* no 5, 88 pp., 10 figs., refs. Rostov-on-Don, 1946. (With a Summary in English.)

Of the six papers in this symposium on *Prangos pabularia*, a wild perennial umbelliferous plant common in mountainous districts in the southern part of

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Central Asia, one deals with its classification, morphology, ecology and geographical distribution, another with the soils in which it grows, and a third is noticed elsewhere [*R.A.E.*, A **36** 118].

In **Chemical Investigation of the Roots of** *Prangos pabularia* (pp. 52–60), D. E. Dionis'ev shows that the roots contain 1·67–9·04 per cent. tannins (dry weight) and the root bark 13·57–19·79 per cent. resins, depending on the season of the year. The content of alkaloids is insignificant. The content of resins was slightly lower at the end than at the beginning of summer, but the content of tannins doubled; both were at their lowest in winter. The composition of the roots remained practically unaltered during storage in summer or winter.

In **Contribution to the Question of the Application of Decoctions of the Roots of** *Prangos pabularia* **for the Treatment of Mange in Farm Animals** (pp. 61–71), G. S. Krok & R. S. Minin describe experiments in 1943–44 similar to those already noticed [B **34** 11]. The decoction was prepared by boiling 5 lb. pounded root bark for two hours in 2 gals. water, kept up to the original amount by the addition of more water, cooling, and allowing to stand for 10–12 hours; it was heated to 40°C. [104°F.] before use. In laboratory tests, examples of *Psoroptes equi*, Hering, and *Sarcoptes* (*Acarus*) *caballi*, Oudm. (*equi*, Gerl.) taken from infested horses and submerged in drops of the decoction kept warm in a damp chamber died only after 20–22 hours. It was applied in April and May to horses infested with *S. caballi*, the hair round the affected parts being clipped and the crusts removed in cases of heavy infestation. The stringy remains of the boiled roots were used to apply the decoction to the whole of the body and rub it into the affected parts. No mites were found in skin scrapings after three treatments at intervals of two days, or after one treatment when the infestation was light. In December and January, only the affected parts were treated, and the decoction was mixed with half the quantity of a decoction of plant ash prepared by boiling one part ash for two hours in five parts water, cooling and straining. Though no examples of either *P. equi* or *S. caballi* occurred in the skin scrapings after the first treatment, a second application of the *Prangos* decoction alone was made after six days. Neither the spring nor the winter treatment had any ill-effect on the animals, the affected areas became covered with hair in 10–12 days, and wounds quickly healed.

Complete control of *P. ovis*, Hering, and *S.* (*A.*) *ovis*, Mégn., on sheep was obtained when the *Prangos* decoction was mixed with half its amount of the decoction of plant ash, but not when it was applied alone three times at intervals of two days, which caused the skin to thicken. Local treatment with the decoction of plant ash followed by the *Prangos* decoction on the following day also gave complete control, but some thickening and creasing of the skin occurred. There were no harmful effects on the wool. The mixture also proved effective against *S.* (*A.*) *caprae*, Fürst., on goats provided that the crusts were scraped off, but was ineffective against *S.* (*A.*) *bubulus*, Oudm., on cattle, probably because it was unable to penetrate beneath the thick crusts to the skin.

In **Preliminary Communication on the Results of Treating Scabies with a Decoction of the Roots of** *Prangos pabularia* (pp. 83–86), K. D. Zaglyadina gives details of the successful use of the decoction against *Sarcoptes scabiei*, Deg.; two of the four cases of scabies first treated were complicated by pyodermatitis. The decoction was prepared by boiling 5 lb. pounded whole root dug in September following the ripening of the seeds, in 1 gal. water for three hours and making up to the original volume, when it was found to contain 3·26 per cent. resins and 1·64 per cent. tannins. It was completely effective at a dilution of 1 : 4 when applied to the whole body or the affected parts repeatedly for a few days, but not at a dilution of 1 : 9. Completely successful results were also obtained with a further 11 cases, for some of which a concentration of 1 : 3 was used. The patients comprised individuals of both sexes and various ages, and no ill-effects on their general condition were observed.

Tavares de Lucena (D.). **Ação do dicloro-difenil-tricloroetano (DDT) sôbre larvas de anofelinos, com referência a outros animais de sangue frio.** [The Action of DDT on Anopheline Larvae, with Reference to other cold-blooded Animals.]—*Arq. Inst. Pesquisas agron.* **4** pp. 143–185, 8 pls., 5 fldg. tables, 1 ref. Pernambuco, 1946. (With a Summary in English.)

The following is based on the author's summary : In September–November 1944, 30 experiments to test the action of DDT in oil or alcohol against mosquito larvae were carried out in three localities near Recife, Brazil. In tanks containing larvae of *Anopheles albitarsis*, Arrib., *A. noroestensis*, Galvão & Lane, and *A. triannulatus*, Neiva & Pinto, 5 per cent. DDT in diesel oil applied at rates equivalent to 50 and 100 gm. DDT per acre gave complete control for up to about three weeks, and at 250 and 500 gm. DDT per acre for 46 and 57 days, respectively. When applied as a 1 per cent. alcohol solution, DDT at concentrations of 1 and 2 parts in 20 million parts water gave complete control for 18 and 23 days, but the stronger concentration also killed fish and tadpoles. Other tests were carried out in small clay borrow pits containing larvae of *A. albitarsis*, *A. noroestensis* and *A. argyritarsis*, R.-D. Complete control for 10, 10–13 and 22 days was given by 5 per cent. DDT in diesel oil used at rates of 50–100, 250–500 and 750–1,000 gm. DDT per acre, respectively, and for 12 and 24 days by a 1 per cent. solution at 250 and 500 gm. DDT per acre, respectively. A solution of 1 per cent. DDT in alcohol at concentrations of 1–8 parts in 20 million parts water gave control for 8–12 days. When applied to a five-acre lake at rates of 50 and 75 gm. DDT per acre, DDT in diesel oil gave complete control for 6 and 8 days, respectively. A pressure-type paint spray-gun was used, preliminary tests having shown that small volumes could not be properly dispersed over the lake by a knapsack sprayer.

It was observed that a considerable time may elapse between the appearance of first- and fourth-instar larvae in the treated water, presumably because, as the potency of the DDT decreases, it takes longer to kill the newly hatched larvae. Complete initial kill was obtained in all the experiments, but when diesel oil was tested alone, a total initial kill was not obtained at concentrations below about 8 gals. per acre. The use of DDT in alcohol is not recommended except when other solvents are unobtainable.

Almost all the treatments effective against the Anophelines also destroyed all mosquito larvae of other genera, but the duration of effectiveness of the DDT against the latter was sometimes not quite so long.

De Meillon (B.). **The Anophelini of the Ethiopian Geographical Region.**—*Publ. S. Afr. Inst. med. Res.* no. 49, $10\frac{1}{2} \times 8$ ins., 272 pp., 85 pls., 2 figs., 1 map, $8\frac{1}{2}$ pp. refs. Johannesburg, 1947. Price 30*s*.

Lists are given of the 70 recognised species of Anophelines of the Ethiopian region and their varieties and of four species the identity of which is in doubt. All belong to the subgenera *Anopheles* and *Myzomia* of the genus *Anopheles*. The phylogeny of Anophelines in the region, the characteristics of the Anopheline fauna of the various parts (east, west, Madagascar, and other islands) and districts of it, the relation of Anophelines to malaria, and types of breeding places are briefly discussed. Keys are given to the eggs, fourth-instar larvae, pupae and adult females of the various species and varieties, and a key to the subgenera, groups and series based partly on adult and partly on larval characters, is also included. These are followed by a systematic description of each species, with notes on its distribution and breeding places and relation to malaria if known. A tabular summary of distribution is appended. The eggs of *A. dureni*, Edw., *A. walravensi*, Edw., and *A. michaeli*, De Meillon & Leeson, are described for the first time.

A. obscurus var. *nowlini*, Evans [*R.A.E.*, B **20** 97], *A. implexus* var. *henrardi*, Wolfs [**34** 152] and *A. rivulorum* var. *garnhamellus*, Evans & Leeson [**26** 40, 75] are not regarded as distinct varieties, as they are based on variable characters. *A. natalensis* var. *puselis*, De Meillon [**22** 232] is considered a synonym of *A. n. multicinctus*, Edw., and *A. rhodesiensis* var. *dthalisimilis*, Corradetti [**27** 176] of *A. rupicolus*, Lewis. *A. culicifacies* var. *adenensis*, Christ. [**13** 14] is raised to specific rank.

ETHERINGTON (D.), HICKLING (S.), RODEN (A. T.) & SELLICK (G.). **Malaria Transmission by unusual Vectors in northern Italy.**—*Riv. Malariol.* **25** no. 1 pp. 1–12, 9 refs. Rome, 1946. (With a Summary in Italian.)

An account is given of the circumstances that led to an outbreak of malaria in 1944 in the town of Vercelli, a relatively isolated community in the Po valley, about 420 feet above sea level. The district was highly malarious in the nineteenth century but the disease had practically died out, only two cases having been reported in the province since 1920. In 1941, treatment with *vivax* malaria was introduced in the Psychiatric Hospital, an institution containing about 600 patients and 100 staff, situated at a distance from the town and closely surrounded by irrigation and drainage ditches, rice-fields and fish ponds, with herds of pigs and cattle in its vicinity and numerous small animals in a shed in its grounds. In 1941–42, infected females of *Anopheles maculipennis*, Mg., obtained from Rome were used, but in 1942–44, the disease was induced by blood inoculation. In all, over 300 patients were infected, the attacks being terminated with quinine, and the treatment was discontinued in 1944.

In 1943, malaria began to occur in patients who had not received malaria therapy and in the hospital staff, and some cases classified as relapses after induced malaria may in reality have been natural infections. In all cases *Plasmodium vivax* was concerned. In addition, between June 1944 and September 1945, 32 cases of malaria were notified in the province of Vercelli and some cases of undiagnosed fever were reported from farms near the hospital.

In June–August 1945, collections of adult mosquitos made near the hospital yielded two examples of *A. maculipennis* var. *melanoon*, Hackett, and 208 of var. *messeae*, Flni. The density of *A. maculipennis* was estimated at 10–500 per room in the hospital and 1,000–5,000 per stable on adjacent farms, but in early October the density had decreased sharply. *A. hyrcanus* var. *pseudopictus*, Grassi, which was not present before July, was fairly numerous in August, particularly in stables, but none was found in October, and dissection of females taken in late August showed no evidence of adult hibernation, whereas of 191 of *A. maculipennis* taken at the same time in the wards and 81 from the stables, 77·5 and 12·3 per cent., respectively, had a developed fat-body.

In August 1945, precipitin tests with the stomach contents of females of *A. maculipennis* that had fed recently gave inconclusive results. Dissections of 113 females of *A. h. pseudopictus*, 206 of *A. m. messeae*, 2 of *A. m. melanoon*, and 198 of unidentified varieties of *A. maculipennis* showed sporozoites in one of *A. h. pseudopictus* and one of *A. m. messeae*, and both sporozoites and oöcysts in one of an unidentified variety.

It is concluded that the main vector was *A. m. messeae*, which is normally zoophilous, and that *A. h. pseudopictus*, which is not normally numerous in malarious districts of Europe and has hence not been suspected as a vector, was of less importance. In general, the outbreak lends support to the view that war conditions, resulting in the introduction of infected persons into a non-malarious area, a reduction in the numbers of domestic animals and enlargement of the available breeding surface, may result in outbreaks of malaria in districts previously free from the disease. Since malaria induced by blood

inoculation is seldom followed by relapses after treatment, it is considered that the source of infection in 1944–45 was to be found in those who had acquired infection accidentally in 1943, as a result of the original mosquito-induced therapeutic infection.

Patrissi (T.). **Epidemiologia della malaria e variazioni della fauna anofelica in rapporto alla bonifica del suolo.** [Epidemiology of Malaria and Variations in Anopheline Fauna in Connection with Land Reclamation.]—*Riv. Malariol.* **25** no. 2 pp. 78–91. Rome, 1946. (With a Summary in English.)

Following a discussion of the effects of land reclamation on the composition of an Anopheline population and the incidence of malaria, with special reference to work in Italy [*cf. R.A.E.*, B **35** 137, etc.], and the effects of introducing fresh gametocyte carriers into an area of low endemicity, an account is given of investigations in 1941–42 in an area to the north of Venice comprising mainly reclaimed parts of the communes of Caorle, Portogruaro and Fossalta di Portogruaro. Malaria is endemic in the area, decreasing in intensity from the coast inland, and is practically absent from the third commune. Although most of the reclamation dates from 1922, there are still occasional outbreaks. The Anophelines taken were *Anopheles maculipennis*, Mg., vars. *typicus*, *messeae*, Flni., *melanoon*, Hackett, and *sacharovi*, Favr (*elutus*, Edw.), and *A. claviger*, Mg. (*bifurcatus*, auct.). The incidence of malaria was lowest where the percentage of *A. m. sacharovi* was small [*cf.* **33** 141]. The salt content of the canal water ranged from 0·08 to 2·72 per cent. ; larvae of *A. maculipennis* were found in several canals, those of var. *sacharovi* occurring in a few in Portogruaro in which the salt content was 2·47–2·72 per cent. Mosquitos were collected fortnightly from June to September in 1942 in houses and animal quarters, and the results are shown in a table. The density of var. *sacharovi* was not always greatest in the areas in which the water was most salt, but the percentage represented by it was lowest (1·2) in Fossalta, where there were no suitable breeding places, and it was concluded that these rare examples had immigrated from neighbouring districts. Precipitin tests showed that the percentage of the Anophelines that had fed on human blood ranged from 0·9 to 27·5 and tended to vary directly with the percentage of *A. m. sacharovi* present in the locality.

Buonomini (G.) & Mariani (M.). **Qual'è il valore sistematico del nome *maculipennis* Meig. ?** [What is the systematic Value of the Name *maculipennis*, Mg. ?]—*Riv. Malariol.* **25** no. 3-4 pp. 101–107, 1 pl., 2 refs. Rome, 1946. (With a Summary in English.)

The authors discuss from their own investigations and the literature the morphological characters of the egg, larva [*cf. R.A.E.*, B **32** 35] and male hypopygium that have been used to distinguish the Palaearctic varieties of *Anopheles maculipennis*, Mg., and from the results of these, and of crossing experiments in the literature [*cf.* **26** 53] and differences in distribution and ecology, they distinguish three species [in contrast to Bates, who recognises five (**29** 41)]. These are *A. maculipennis*, including race *messeae*, Flni., egg varieties *melanoon*, Hackett, *fallax*, Roub., and *subalpinus*, Hackett & Lewis, and biotype *cambournaci*, Roub. & Treill. ; *A. labranchiae*, Flni., including race *atroparvus*, van Thiel, and egg varieties *pergusae*, Miss., and *sicaulti*, Roub. ; and *A. sacharovi*, Favr. The geographical distribution of the three species is shown on a map, and a new specific group within the subgenus *Anopheles*, named *Maculipennia*, is erected for them. The diagnostic characters of this group are described, and characters are given in a table distinguishing

the three species in the egg, larval and adult stages (these last consisting mainly of differences in the male hypopygia), with notes on habits. A list of the Italian Anophelines is included.

De Negri (U.). **Sorgenti metanifere e malaria nel Polesine. (Nota preventiva.)** [Methane Wells and Malaria in the Po Valley. (Preliminary Note.)]—*Riv. Malariol.* **25** no. 6 pp. 217–223, 1 fig., 1 map. Rome, 1946. (With a Summary in English.)

In 1934, methane gas was discovered in the valley of the Po, and since that time about 300 wells have been sunk for its extraction, more than half of them in the delta of the river. A map is given showing the distribution of the chief centres. These wells bring up considerable quantities of salt water (containing 14–24 per cent. sodium chloride), which flows into the surface drainage system of the district. Between 1942 and 1945, there was a recrudescence of malaria in the region, including numerous cases in localities from which it had previously been eradicated. It was due not only to wartime conditions but also to a marked increase in the population of *Anopheles maculipennis* var. *sacharovi*, Favr (*elutus*, Edw.), which breeds in salt water, and its spread to new localities. This proceeded in direct proportion to the increase in the number of wells, and the consequent increase in salt surface-water available. Figures showing the changes in the Anopheline population and the incidence of malaria in some of the localities concerned are given in tables. It is recommended that the salt water should be conveyed in pipes to large rivers, where it will be too diluted to provide breeding places for var. *sacharovi*.

Torres Cañamares (F.). **Nuevos datos sobre el *Anopheles marteri* Sen. y Pru. en España. ¿ Se trata de una variedad ? (Dipt. Cul.)** [New Data on *A. marteri* in Spain. Is it a Variety ?]—*Eos* **22** pt. 1–2 pp. 47–58, 1 pl., 5 figs., 11 refs. Madrid, 1946.

Comparison of the Anopheline found in Spain in the Provinces of Granada and Cuenca and identified as *Anopheles marteri*, Sen. & Prun. [*R.A.E.*, B **34** 18] with Senevet's descriptions and figures of this species [**16** 189 ; **18** 35 ; **21** 83] has led the author to conclude that it is in reality a variety of it, which he describes from all stages as *A. marteri* var. *conquensis*, n. Characters distinguishing the adults and larvae of *A. marteri*, the new variety and *A. sogdianus*, Keshish'yan, which is also probably a variety of *A. marteri* [*cf.* **27** 183] are given in a table. The larvae of *A. m. conquensis* were usually found in clear mountain water, shaded and nearly still, often in association with *A. claviger*, Mg., and sometimes with *A. hispaniola*, Theo., or *A. maculipennis* var. *atroparvus*, van Thiel. In the laboratory, in water at a temperature of 20°C. [68°F.], only three examples out of 43 reached the adult stage ; the egg, larval and pupal stages lasted 4–5, 39–51 and 4 days, respectively. The adults sheltered in damp, dark crevices in the ground or in masonry ; they were seldom found in houses, but females were taken in June and February in a pig-sty. Of those taken in June, one contained undigested blood and another eggs ; females containing eggs were found in the open country in June and September. Winter was passed in the adult stage ; in October 1945, in intense cold, females were taken with a developed fat-body. *A. m. conquensis* is a mountain variety, occurring at altitudes of nearly 3,300 ft.

Edney (E. B.). **Laboratory Studies on the Bionomics of the Rat Fleas, *Xenopsylla brasiliensis*, Baker and *X. cheopis*, Roths. III. Further Factors affecting Adult Longevity.**—*Bull. ent. Res.* **38** pt. 3 pp. 389–404, 16 refs. London, 1947.

The following is based on the author's introduction and summary. The length of life of unfed adults of *Xenopsylla* is known to vary with temperature

and humidity [*cf. R.A.E.*, B **13** 128; **20** 181; **24** 17, 250] and it has also been shown to be affected by psychrometric conditions during the larval and pupal stages [**33** 76; **36** 16]. When these factors have been allowed for, however, there is still more variation than would be expected.

In the work described, an attempt was made to determine if possible the causes of these discrepancies. *X. brasiliensis*, Baker, was the flea principally used, but observations on small numbers of *X. cheopis*, Roths., showed no significant differences on behaviour between the species. The survival period of unfed adults was found to be significantly reduced if the larvae were reared together rather than in separate tubes, if the parent fleas were over 11 days old, if very fine rather than coarse sand was used as a matrix for the larval food [*cf.* A **33** 188], or if the blood for larval food was dried by baking rather than in a vacuum over sulphuric acid at room temperature. Contamination of the larval food by mice and their droppings and the presence or absence of the faeces of adult fleas in it had no significant effect on length of adult life. The effect upon the weight of the larvae and the duration of the larval period of some of the above factors is described. The larval period is shown to be shorter in females than in males under all the conditions used.

It is confirmed that there is no significant difference in length of adult life between males and females that have fed once or not at all, but females that have fed frequently before starvation live longer than males. Well-developed, unfed, laboratory-bred fleas live longer than those that have fed once before starvation, and the latter live longer than those that have fed several times. There is evidence that unfed fleas caught in nature live longer than fleas that have fed before they are caught, but this needs confirmation. All the available information regarding factors affecting length of adult life is summarised in a table.

Johnson (C. G.) & Walton (W. H.). **The Effect of Area Dosage, Solution Concentration and Drop Size of sprayed Solutions and Emulsions of DDT against Mosquito Larvae.**—*Bull. ent. Res.* **38** pt. 3 pp. 405–430, 4 pls., 15 figs. London, 1947.

An account is given of tests designed to assess the potential effectiveness of DDT sprays against mosquito larvae under natural conditions and to determine the most effective form of spray. They were made in August and September 1944 in a canal in southern England harbouring larvae of *Anopheles maculipennis* var. *messeae*, Flni., and *A. claviger*, Mg. The central channel was so overgrown with *Potamogeton natans* that in places more than half the surface appeared to be covered. In some parts, there were large floating masses of a coarse species of *Spirogyra*. The canal was 40 ft. wide, and was edged with belts of tall vegetation 1–5 ft. wide. Each test was carried out over a stretch 20 ft. long.

The spinning-disk atomiser used was specially designed. It gave drops of nearly uniform size and enabled drop size and dosage delivered to be varied independently. The range of dosages investigated was 4 to 80 gm. DDT per acre delivered in ordinary oil solutions containing about 0·5 and 5 per cent. DDT or emulsified solutions containing about 0·5 per cent., with drops about 0·4 or 1 mm. in diameter. The smaller drops simulated spray applied from aircraft. The standard 5 per cent. solution consisted of 10 gm. pure DDT (active isomer only), 50 ml. heavy solvent naphtha, 150 ml. heavy lubricating oil and (to make the oil spread) 1 ml. oleic acid. The emulsion was prepared by adding distilled water to a concentrate (AMSO-1) comprising 30 gm. pure DDT, 400 ml. pool 3 oil and 200 ml. of a proprietary emulsifying agent (Amoa A5X) consisting substantially of sodium oleate and cresol.

Assessment of surface dosage in relation to delivered dosage, by spraying dyed solutions, showed that about 30 per cent. of the smaller drops were lost in

the wind, but that there was no appreciable loss of the coarser spray. The drop size did not influence the kill effected by solutions of 5 per cent. DDT in oil, except at dosages lower than 10 gm. DDT per acre, when the greater loss of small drops in the wind produced variable results. No tests on the effect of drop size were made with emulsions. Experiments on the effect of concentration at constant dosage for a given area were made only among the marginal vegetation. They did not indicate that any increase in larvicidal action would be derived from distributing DDT in high dilutions. With a dosage of 10 gm. DDT per acre, a 4·3 per cent. solution actually gave a higher mortality than a 0·43 per cent. solution, but the difference may not have been significant owing to uncontrollable variables. Both unemulsified oil solutions were much superior to emulsions containing 0·43 per cent. DDT, which did not reduce populations much below levels in control strips. Oil alone was not lethal.

In the centre of the canal, mortalities greater than 90 per cent. were obtained with both the emulsified and unemulsified solutions at delivered dosages greater than 10 gm. DDT per acre, the unemulsified solution being slightly superior. In the tall vegetation of the margin, the kill dropped sharply with emulsions at dosages below 40 gm. DDT per acre. The fall-off was much less marked with unemulsified solution. From consideration of the average mortality in all areas, a delivered dosage of 40 gm. DDT per acre (small drops) or an estimated surface dosage of about 30 gm. DDT per acre is thought to make the most economical use of DDT. With small drops, an average mortality of 91 per cent. was effected by a delivered dose of 25 gm. DDT per acre in the solution, and 90 per cent. by 40 gm. per acre in the emulsion and by 12·5 gm. in the solution. It is suggested that the inferiority of the emulsion may be due to loss of DDT at the surface because some of it disperses through the water or to some repellent action exercised by the emulsifier. Larvae in the first two instars were more easily killed by DDT than older larvae or pupae, and the proportion of pupae and older larvae in sprayed areas therefore rose sharply. However, the population reached its original composition though not its original level, after about three weeks. This indicates that the films did not remain lethal for more than three days. Larval populations remained very low following the initial kill in these trials, but this was thought to be due to a natural decline in the reproductive potential.

VANDERPLANK (F. L.). **Some Observations on the Hunger-cycle of the Tsetse-flies *Glossina swynnertoni* and *G. pallidipes* (Diptera) in the Field.**—*Bull. ent. Res.* **38** pt. 3 pp. 431–438, 1 fig., 7 refs. London, 1947.

The mean hunger-cycles of *Glossina swynnertoni*, Aust., and *G. pallidipes*, Aust., were studied in 1940 and 1941 near Old Shinyanga, Tanganyika, by cutting off the proboscis of male tsetses caught on a tethered ox, marking the flies according to date and stage of hunger, releasing them and recapturing some. The percentages recaptured varied from 15 to 30 according to density of population, number of baits used and time given to catching. The length of time that hungry flies can survive before dying of starvation was considered in studies with *G. swynnertoni*. In December and January, no males that were very hungry when released were recaptured more than two days later. In February, the greatest number was recaptured on the second day, but nearly as many were taken on the third and a few on the fourth. As February was hotter and drier than the two preceding months, it is thought that the fly must have better reserves of food in that month, when a short dry break occurs during the rains. In June and July, when hungry flies were again released, all flies recaptured were taken one day after release. The evaporation rate was slightly higher in June than in February, but temperatures were lower.

A study of the recapture of flies that were allowed to engorge before release showed that the mean hunger-cycle also varied with the season and was correlated significantly with the evaporation rate and other measurements of humidity. The variation of temperature experienced in the experiments was not sufficient to have any appreciable effect on the hunger-cycle. In the case of *G. swynnertoni*, the times between a meal and recapture in a state to feed again varied from 4 to 12 days in January and 2 to 7 days in July. These may be considered the maximum and minimum observed hunger-cycles. Numerous causes may contribute to make the range so large, such as the age of the fly, its activity at the time and the size of the original meal. The mean hunger-cycles of *G. swynnertoni* and *G. pallidipes* were about 7–8 and 5 days, respectively, at an evaporation rate of about 30 cc. per day, but the difference between them decreased as the evaporation rate rose until they became almost identical (about 4 days) when it reached about 60 cc. These field results do not appear to support Jackson's conclusions from laboratory work with the *morsitans* group [*R.A.E.*, B **34** 198], from which it would be expected that *G. swynnertoni*, the smaller fly, would have the shorter hunger-cycle. However, Jackson's experiments were carried out at a relative humidity of 50 per cent. and a temperature of 25·3°C. [77·54°F.], which is approximately equivalent to an evaporation rate of 65 cc. when the wind velocity is 1·5 m.p.h. From the graph of the author's experimental results, it appears probable that *G. pallidipes* and *G. swynnertoni* have about the same hunger-cycle at this evaporation rate.

THOMSON (R. C. M.). **The Effects of House Spraying with Pyrethrum and with DDT on *Anopheles gambiae* and *A. melas* in West Africa.**—*Bull. ent. Res.* **38** pt. 3 pp. 449–464, 23 refs. London, 1947.

In the course of observations on the behaviour of *Anopheles gambiae*, Giles, and *A. melas*, Theo., in houses in Lagos, Nigeria, in 1945–46, it was found that in both species, which have normally a 48-hour gonotrophic cycle in Nigeria and Sierra Leone, the numbers of blood-fed females (those that had fed the night before) resting in houses were always much greater than the numbers of gravid females (those that had fed two nights before). Some of the latter must therefore rest elsewhere. After persistent searching outdoors, adults were found occasionally in holes and crevices of well-shaded termite mounds and in folds and fissures on the shaded trunks of large forest trees, and regularly in certain heavily shaded earth banks. Almost equal numbers of blood-fed and gravid females were found, in addition to unfed and unfertilised ones.

Mosquitos leaving the house between dusk and dawn were attracted by the faint light coming in through windows, open doors and wide spaces in the eaves. Those that had not left by dawn were not attracted by daylight coming in at the windows. These observations were confirmed by the use of traps over the windows of specially constructed mud huts to which light could not penetrate in any other way. It was found that 90 per cent. of blood-meals were taken after midnight, with the peak of feeding an hour or two before dawn. Even when the hut offered ideal dark day-time resting places, many blood-fed females left at dawn, and many of those remaining left at dusk on the following evening. Much more light enters most village houses, and the mosquitos caught there during the day may be only a small proportion of those that fed at night. *A. gambiae* and *A. melas* are thus not so susceptible as was thought to control measures directed against the adults.

Mass spraying of isolated villages four times a week with pyrethrum extract (Pyefly) in kerosene (1 : 59) at $\frac{1}{2}$–$\frac{3}{4}$ oz. per 1,000 cu. ft., at a season when production of *A. gambiae* and *A. melas* was steady, was highly effective in killing

the mosquitos and reduced the day-time catch of these species to one-third. The sporozoite rate remained practically unchanged. Even spraying six times a week failed to reduce either the number of mosquitos or the sporozoite rate substantially. Observations in which the mosquitos had the choice of entering a sprayed or untreated experimental hut, each occupied by two men, showed that pyrethrum repelled many hungry Anophelines (mainly *A. melas* at this time) for about three days after spraying. By the fifth day, the effects of spraying had almost disappeared. On the first and second days, about two-thirds of the mosquitos that fed in the sprayed hut left after doing so, but more were found in the hut than in the window trap by the third day. When, however, all available huts occupied by man were sprayed, hungry females were not greatly repelled but continued to feed in large numbers even in huts sprayed every day. Daily spraying of all huts occupied by man did not increase the number of *A. melas* feeding on animals in untreated huts. The percentages of females leaving at dawn after feeding were about 20 and 80 in unsprayed huts and huts sprayed daily, respectively. It is pointed out that Ribbands' estimate that 90 per cent. of *A. minimus*, Theo., were deterred from entering huts in Assam on the first day after spraying [*R.A.E.*, B **34** 200] was based on numbers in the huts on the next day, and that unless account is taken of mosquitos leaving, it is almost impossible to say what proportion is deterred from feeding. If spraying is done weekly (a spacing sufficient only against mild vectors), repellent effect largely wears off between applications, but the more often spraying is carried out the smaller is the population directly affected. It is concluded that as intense house spraying with pyrethrum does not substantially reduce the numbers or infectivity of Anophelines, but results in a shift from indoor to outdoor resting places, it is not of great value in West Africa as an anti-malaria measure.

One mass spraying of the walls and ceilings of village houses with 5 per cent. DDT in kerosene at 100–125 mg. DDT per sq. ft. reduced the day catch of resting females of *A. gambiae* and *A. melas* almost to nil for four weeks, and kept it fairly low for two months, at a time when the output in the area was shown to be high. However, observations in the experimental huts showed that Anophelines (in this case principally *A. melas*) may enter and feed within a few days of treatment with DDT in kerosene ; the number doing so increased steadily and was quite large by the second week after treatment. Moreover, there was no appreciable mortality in the 48 hours following capture among these females, all of which attempted to leave the hut and were caught in the window trap. There was no evidence of any females succumbing to the insecticide inside the hut. Thus the DDT did not prevent the females from feeding but had a marked irritant effect, driving them out of the house after they had fed and preventing them from resting long enough on treated surfaces to absorb a lethal dose. A few days of complete protection from biting followed spraying, but this was shown by an experiment with kerosene alone to be due mainly, if not entirely, to the repellent effect of the latter. Treatment of all rooms in an isolated village with 5 per cent. DDT in kerosene at 200 mg. DDT per sq. ft. reduced the day catch of Anophelines to nil for five weeks, whereas blood-fed and gravid females (mostly *A. melas*), 2 per cent. of which had sporozoites in the salivary glands, were taken regularly during this period in outdoor resting places near the houses. The results obtained suggest that the apparent elimination of mosquitos from houses by treatment with DDT in kerosene is due to a complete shift to outdoor resting places, on account of the residual irritant [*cf.* **34** 189 ; **35** 107, 108], but not lethal, effect of the treated surfaces. The sharp fall in indoor catches following treatment in West African villages cannot, therefore, be accepted as evidence of effective control. The results are compared with those obtained by other workers with *A. gambiae* and other species of *Anopheles* [**34** 189 ; **35** 13–14, 69, 188].

Glasgow (J. P.) & Duffy (B. J.). **The Extermination of** *Glossina palpalis fuscipes*, **Newstead, by Hand Catching.**—*Bull. ent. Res.* **38** pt. 3 pp. 465–477, 1 pl., 2 maps, 4 refs. London, 1947.

Symes & Vane [*R.A.E.*, B **25** 165] and Hunt & Bloss [**36** 27–28] showed that *Glossina palpalis fuscipes*, Newst., could be sufficiently reduced in numbers by hand-catching to control sleeping sickness caused by *Trypanosoma gambiense*, and Symes & Vane considered that they had achieved eradication along some streams. To re-examine the possibility of eradicating this tsetse by hand-catching, two blocks on a small river in the South Kavirondo District of Kenya with a narrow strip of riverine bush and a low density of the fly (an apparent density of less than 50 non-teneral males per 10,000 yards) were isolated by carefully maintained clearings 5,000 yards or more long. The removal of a focus of sleeping sickness was aimed at incidentally. The vegetation in and near the blocks is described. The upstream block was used for the experiment, and the downstream block served as a control; had the fly disappeared from the latter, it would have shown that its existence along a stream of the type concerned necessitated constant immigration from more heavily infested places lower down. In February, March and April 1945, the two blocks were shown to have about the same tsetse populations (10–15 and 13–17 non-teneral males per 10,000 yards). More than half the non-teneral flies taken were females. The reason for this high percentage, which is general in the streams of the observation area, is not known.

The catching of flies in the experimental block, which was nearly 4,000 yards long, began on 1st May 1945. Catchers at the rate of six per 1,000 yards of stream, working six days a week in teams of three with hessian screens, caught 399 flies in May–July, seven in August–October, and none in November or December. Hand catching was then regarded as complete and the catchers withdrawn, except for a party of three maintained to give early warning of reinfestation. The party caught one non-teneral male in January 1946. As it was thought that this catching might prevent reinfestation, it was stopped and reconnaissance once a month without nets was substituted. One fly was seen in March and one in April. In June, 14 fly-boys patrolled the block for 14 days and found no evidence of reinfestation. The fly persisted in the control block for the 16 months following its isolation, and it is believed that without control measures it would persist for ever. Many reconnaissances were made in the clearings below the two blocks, but no individuals of *G. p. fuscipes* were taken except for a few that penetrated a couple of hundred yards into the bottom end of the lower clearing. Marking of large numbers of flies in the control block from May 1945 to July 1946 showed also that the clearings were effective except where thickets on tributaries were serving as stepping stones for the spread of the fly. When these thickets had been removed, no more marked flies were caught outside the control block, though the fly seen in the experimental block in April was one that had been marked 2–3 weeks before.

The area from which Symes & Vane claimed to have eradicated the fly ten years earlier by hand catching [**25** 166] was examined, and a few individuals were taken. However, the streams were very much exposed to reinfestation, being isolated by a clearing only 1,050 yards long, and the finding of so few flies is taken to indicate that hand-catching is a very useful method of reclamation. Permanent water appeared to be necessary for reinfestation. It is concluded that hand-catching is the quickest and cheapest known method of reclaiming streams of this type from *G. p. fuscipes*. Its disadvantages are the possibility of reinfestation and the fact that fly-catchers require more supervision than bush-felling labourers. It is not maintained that a 5,000-yard clearing will always stop *G. p. fuscipes*.

A brief account of the first five months of hand-catching in the control block, which was begun in December 1946, is given in an appendix. Catchers worked in teams of two without a screen. Total catches fell from 67 in December to 5 in February and 2 in April. The original experimental block was patrolled for six days in May 1947 by 18 trained catchers, and no fly was caught or seen.

JACUSIEL (F.). **Sandfly Control with DDT residual Spray. Field Experiments in Palestine.**—*Bull. ent. Res.* **38** pt. 3 pp. 479–488, 3 refs. London, 1947.

Experiments on the effectiveness of DDT sprays applied to leave a toxic residue for the control of *Phlebotomus* spp. in houses were carried out in 1945 in Rosh Pina, in the Galilee district of northern Palestine. The prevalent species were *P. papatasii*, Scop., *P. major*, Annan., and *P. chinensis* var. *simici*, Nitzu. The relative distribution of these species in and outside houses in the evening (8 p.m. onwards) and in houses in the morning (6–8.30 a.m.) is shown in a table. The average number of sandflies taken per room was 17 and the maximum 126. The DDT was applied as a 2·5 or 5 per cent. solution of the p,p′ compound in kerosene at 1 gal. per 100 sq. metres (100 or 200 mg. DDT per sq. ft.), either to the walls and the whole ceiling or to the walls and a strip of ceiling one ft. wide at the junction with the walls. The results are discussed in detail for each of the five groups of rooms in the village in which tests were made.

Spraying reduced sandfly counts to nil in treated rooms of all groups and, apart from a total catch of ten sandflies in three of the five groups, maintained it at nil from the time of spraying at the middle or end of August or beginning of September until early October (a maximum period of 58 days [*cf. R.A.E.*, B **34** 63]). As the deposit was active until the sandfly season was over, the maximum duration of effectiveness could not be assessed. Maximum temperatures during the test period had ranged from 24·6 to 37·5°C. [76·28 to 99·5°F.], minimum temperatures from 14·4 to 26·6°C. [57·92 to 79·88°F.] and relative humidities from 12 to 70 per cent. The two methods and two rates of application gave equally good results, and there was no difference in the degree of control of the three species. Comparison of the average counts in a treated room or rooms for periods of 4–5 days, including a day on which control was not complete, with the average count during the same period in control rooms of the same test group and with the five-day average count of the test room or rooms before treatment showed that the reduction of sandflies at these times was always over 97 per cent. compared with pre-treatment counts and over 92 per cent. compared with control counts. After spraying, inhabitants of the treated room enjoyed complete freedom from bites. Treatment of one room in a house considerably reduced the catch of *Phlebotomus* in other rooms. An attempt to protect a house by spraying vertical surfaces (stone walls, etc.) within a radius of 50 yards failed. Sandflies disappeared from the treated surfaces, but apparently much larger areas would have to be sprayed to make the measure effective although breeding places in the immediate neighbourhood of the houses were abundant. A general reduction of the sandfly population could be expected to follow large-scale treatment with DDT of buildings in a village or camp area, particularly if the first application was made just before the expected emergence of the first generation after hibernation. In Palestine, this is at the end of April.

During the summer of 1945, all military camps and installations in Palestine were sprayed with DDT about every two months, usually from the end of April. The effect of this on the incidence of sandfly fever is discussed. Whereas non-immune replacement troops were more numerous in 1945 than in 1944, the sandfly-fever rate in the latter year was only about one-tenth of that in the former. There was also a marked reduction in the incidence of fever of unknown

origin. At a station with a continuous influx of non-immune personnel, where infestation was heavy in the spring of 1945 and large numbers of fever cases began to appear in May and early June, large-scale DDT treatment was carried out in mid-June and re-applications were made at intervals of six weeks until October. The incidence of sandfly fever fell abruptly at the end of June and remained negligible throughout the peak season (August–October).

HADAWAY (A.) & BARLOW (F.). **Toxicity of DDT applied to Limewash.**—*Bull. ent. Res.* **38** pt. 3 pp. 489–495. London, 1947.

An account is given of laboratory tests in Uganda to determine the effectiveness of DDT when applied to limewash and the cause of any loss of toxicity. The question is of importance in view of the extensive use of limewash in European houses in the tropics [*cf. R.A.E.*, B **36** 20]. Limewash made from partly slaked lime, the analysis of which is given, was applied to glass plates, which, together with clean plates, were then placed on the ground in a measured area and sprayed with a known volume of insecticide. Deposits varied considerably. The spray generally used was a 5 per cent. solution of DDT (83 per cent. p,p') in power kerosene. The test insects, principally *Glossina palpalis*, R.-D., 7–10 days old, and occasionally *Aëdes aegypti*, L., and *Anopheles gambiae*, Giles, were exposed to the treated surface individually in tubes, for 20 seconds unless otherwise stated. Deaths among controls were negligible. A briefer account of many of the results has already been noticed [*loc. cit.*].

Glass plates treated with the DDT spray from three hours to eight weeks after they had been limewashed gave kills of 10–46·7 per cent. in 24 hours of *G. palpalis* exposed 24 hours after spraying, irrespective of the age of the limewash, whereas DDT on plain glass gave 100 per cent. kill in nearly all cases. The weight of the lime on the plates varied from 7·6 to 13·6 gm. per sq. ft. More DDT was recovered from the limewashed plates than the controls in most instances. The amount of DDT adsorbed on the lime particles was shown to be too small to explain the non-availability of the insecticide. It can also be assumed that the loss of toxicity was not due to decomposition. Most of the DDT could be recovered. When extraction was made from glass plates that showed little or no toxicity after being limewashed and treated with DDT, and 20 mg. of the crystallised extract was dissolved in ether and applied to a clean glass plate to give a dosage of 80 mg. per sq. ft., a kill of 83·3 per cent. of *G. palpalis* exposed three days later was effected in 24 hours. When the flies were exposed for 20 seconds and 1, 2 and 5 minutes to a glass plate sprayed with the DDT solution one week previously and eight weeks after being limewashed, kills of 25, 60, 60 and 80 per cent. were effected in 24 hours and 40, 65, 90 and 89 per cent. in 48 hours. DDT alone gave complete kill in 24 hours. The amounts of DDT subsequently recovered from the plate that had received limewash and the one that had not were 240 and 152 mg. per sq. ft., respectively. From the progressively higher kills obtained with increasing exposures of *G. palpalis* (up to 15 minutes) and mosquitos (up to 2 hours), 24 hours, two weeks and four weeks after spraying, to heavy deposits of DDT (378 mg. per sq. ft. after four weeks) on glass limewashed a week before being sprayed, it is concluded that the loss of toxicity is due mainly to absorption and the consequent masking of the insecticide. Insects must remain in contact with the treated limewash for much longer than is necessary on simple DDT deposits to obtain similar results. As the layer of lime on the glass in the tests was very thin, the loss of toxicity suggests that the available insecticidal layer also is very thin.

The addition of an adhesive to the limewash did not prevent absorption, and a loss of toxicity also occurred when the DDT was applied to the lime in an emulsified oil solution. A 2 per cent. suspension of DDT in water (made from DDT dispersible powder Guesarol), applied to glass plates limewashed one week earlier, effected about the same kill of *G. palpalis* exposed for two minutes, either

24 hours or two weeks after the application, as it did on plates that received no lime. Longer contact with deposits from suspensions than with those from solutions was necessary to produce fairly high kills whether lime had been applied or not. This is probably because of the masking effect of the inert material making up the bulk of the powder.

Exposures of 5 and 15 minutes to a glass plate that had received a thin coating of a water paint containing DDT one week earlier effected 10 and 50 per cent. kills of *G. palpalis*, respectively, and the kill of 82 *A. gambiae* exposed for one hour was 57 per cent. The amount of DDT recovered from the plate was 70 mg. per sq. ft. When the coating of paint was thick, the corresponding mortalities were very similar (13, 60 and 50 per cent. respectively), whereas the amount of DDT recovered was 623 mg. per sq. ft. When the paint dries, much of the insecticide must be below the surface, leaving only a very thin layer available for contact.

NASH (T. A. M.). **A Record of *Syntomosphyrum glossinae* from Nigeria.**—*Bull. ent. Res.* **38** pt. 3 p. 525. London, 1947.

In April 1947, a stock of puparia of *Glossina palpalis*, R.-D., collected in the Kaduna area suddenly became heavily infested with *Syntomosphyrum glossinae*, Wtstn. It is presumed that a parasitised pupa had been brought in from the bush and a few adult parasites had emerged and remained undetected. This is believed to be the first record of the parasite from West Africa, and is taken to indicate that it is indigenous in Nigeria. Its presence cannot be attributed to the attempt made to introduce it more than 20 years before [*R.A.E.*, B **15** 168], since it was then released at Sherifuri, 210 miles north-east of Kaduna, and was not subsequently recovered from any pupae of *Glossina* collected at the site or from thousands collected in adjacent country between 1927 and 1943. Its failure to survive at Sherifuri was possibly due to the very high dry-season temperature and low humidity there.

BLAIR (D. M.). **Baited Fly Traps. (Supplement.)**—*Rhod. agric. J.* **43** no. 2 pp. 122–125, 11 figs. ; also as *Bull. Minist. Agric.* [*S. Rhod.*] no. 1344, 5 pp., 11 figs. Salisbury, S. Rhod., 1946.

Further figures and explanations are given to show in more detail the method of constructing the standard M.E.F. trap for flies already noticed [*R.A.E.*, B **36** 49].

[PAVLOVSKIĬ (E. N.).] Ed. **Павловский (Е. Н.). Parasitology of the Far East.** [*In Russian.*]—*Kraev. Parazitol. SSSR* **1** $8\frac{3}{4}\times6$ ins., 427 pp., 3 col. pls., 189 figs., many refs. Leningrad, Medgiz, 1947. Price 24 *rub.* 75 *kop.*

This handbook, to which seven authors have contributed, is the first of a proposed series of surveys of the parasitic diseases of man that occur in the various regions of the Soviet Union, and deals with those observed in the Far East. An introduction in which E. N. Pavlovskiĭ reviews the work of the various scientific expeditions that have carried out investigations in that region since 1935 is followed by nine chapters on Arthropods that transmit diseases or are otherwise harmful to man. Much of the information in these has already been noticed from papers by the authors. The first three are by A. V. Gutzevich and deal, respectively, with blood-sucking Diptera (mosquitos, Simuliids, Ceratopogonids and Tabanids) in the Far East [*R.A.E.*, B **34** 73, etc.] ; the two mosquito vectors of malaria in the Far East, *Anopheles hyrcanus*, Pall., and *A. maculipennis*, Mg. [**33** 184 ; **34** 40] ; and the literature on the relation of mosquitos to epidemic encephalitis in Japan [**31** 2, 3]. In the fourth and

fifth, P. A. Petrishcheva reviews the mosquito vectors of this disease in the Maritime Province [**31** 72] and all the blood-sucking mosquitos of that Province, where *A. hyrcanus* is the only Anopheline. These are followed by three chapters by Pavlovskiĭ on the Ixodid ticks of the Far East, their relation to spring-summer encephalitis [**31** 70, 71 ; **34** 67–70, 113] and their importance as vectors of spotted fever [**34** 113]. The ninth chapter, by G. S. Pervomaĭskiĭ, is a review of various methods of controlling ticks [**34** 70, 113] and includes a note on the parasite, *Hunterellus hookeri*, How. [**32** 214]. The remaining chapters, by G. Ya. Zmeev, deal with parasite worms and protozoa, and there is an appendix by B. S. Vinogradov on the rodents of the southern part of the Far East.

[Gladenko (I. N.).] **Гладенко (И. Н.). Treatment of *Psoroptes* Mange in Cattle by Means of Sulphur-lime Dust.** [*In Russian.*]—*Veterinariya* **23** no. 12 pp. 12–14. Moscow, 1946.

Investigations by M. A. Palimpsestov have shown that mites of the genus *Psoroptes* are susceptible to lack of moisture and can be destroyed by applying dehydrating agents to the skin of infested animals, and, in experiments by him and the author in 1944–45, sheep were completely freed from *P. ovis*, Hering, by the use of a sulphur-lime dust, with no reinfestation during the eight months that they were under observation.

In view of this and because liniments are costly and unsuitable for use in winter, when mange is particularly common, and treatment with sodium thiosulphate and sodium bisulphate [*R.A.E.*, B **34** 11] is also expensive and requires preliminary grooming of the animals, experiments with a sulphur-lime dust were carried out by the author in January–March 1946 in the Province of Kharkov on cattle infested by *P. bovis*, Gerl. The dust was prepared by mixing 30 parts flowers of sulphur or ground sulphur with 50 parts fine chalk powder and then adding 20 parts chloride of lime (30–35 per cent. active chlorine), and thoroughly mixing the whole. It was applied to the whole body surface of the animals from a jar with a perforated metal lid and was lightly rubbed in with a cloth or brush on the abdomen, legs and lower surface of the neck. The treatment was repeated three times at intervals of three days, the amount of dust used per head being about 2 lb. for the first application and 1½ lb. for each of the others. It was applied indoors and in the open, and the animals received no preliminary washing. The cattle sheds and the various implements used in handling the cattle were cleaned and disinfected at the same time. Observations for 3½ months following the treatment showed that irritation ceased after the second application of the dust and that no living examples of *P. bovis* in any stage of development occurred in skin scrapings after the third. The treatment had no ill-effect on the animals, the scars caused by their rubbing healed rapidly, and the infested parts became covered with hair.

Delpy (L. P.) & Rafyi (A.). **Sur les " réservoirs de virus " de la fièvre récurrente sporadique en Iran.**—*C. R. Soc. Biol.* **140** no. 1–2 pp. 62–63, 4 refs. Paris, 1946.

Continued experiments in Persia, where relapsing fever caused by *Spirochaeta persica* is transmitted to man by *Ornithodoros tholozani*, Lab. & Mégn. [*cf. R.A.E.*, B **27** 150] showed that the spirochaete can survive in the adult tick for 1,175 days and in the nymph for 1,403 days [*cf.* **33** 165]. Larvae, nymphs and adults were infective 1,230, 829 and 2,066 days after their parents had been infected as adults, nymphs and adults, respectively. The ticks in question were not consistently infective throughout the intervening period [*cf.* **33** 197]. The spirochaete survived for 593 days in the brain of white rat, but rat blood could not be shown to remain infective for more than 37 days. Sheep's blood remained infective for more than two months. *O. tholozani* lives in crevices in dwellings and engorges at night, preferably on human blood.

Garnham (P. C. C.). **Malaria Epidemics at exceptionally high Altitudes in Kenya.**—*Brit. med. J.* 1945 **2** pp. 45–47, 6 refs. London, 14th July 1945.

It is usually considered that malaria is not transmitted at altitudes of more than about 6,000 ft. [*R.A.E.*, B **32** 97], though there are doubtful records of transmission at Addis Ababa, Abyssinia, at 8,175 ft. [*cf.* **31** 242–243]. Hitherto, places above 7,000 ft. in Kenya have been thought to be free from the disease, but a severe epidemic occurred in June–August 1941 among both Europeans and Africans in a small farming community and in a military camp at Londiani at 7,500–7,800 ft. Blood slides taken from 35 sick Africans showed that 26 were infected with *Plasmodium falciparum* and one with *P. vivax*. Smaller outbreaks occurred at the same time of year in 1942–44. The district is described. Much of the country becomes waterlogged in rainy weather and so provides ample facilities for mosquito breeding. The farms adjoin extensive forest reserves, but little malaria occurred in the isolated huts of the forest squatters. In May–June 1944, a localised outbreak, caused by *P. falciparum* and lasting only a fortnight, occurred on a farm about 20 miles north of Londiani at an altitude of 8,300–8,500 ft.

Records are given of the seven species of *Anopheles* found in different months at Londiani, six in the larval and six in the adult stages, in surveys made between December 1927 and January 1944 ; the only one known to transmit malaria was *A. gambiae*, Giles, of which larvae were taken in May and adults in June and July. Two females of this species were also found at the farm to the north, where there were suitable breeding places for it. In both places, the adults obtained were from dwellings. The salivary glands of all females from Londiani were examined, but no sporozoites were found. The surveys there indicated that *A. gambiae* breeds for a short period about May and that adults persist for about two months afterwards.

Climatic records for Londiani and for the Equator station ten miles from the farm and about 500 ft. higher are given. They show that the rainfall in several months at both places is adequate for *A. gambiae* to breed, but that the temperature is below 61°F., which has been regarded as the minimum for its breeding [*cf.* **22** 54], except in March on the farm and from February to May at Londiani, and that the rainfall is too low for breeding in February. Outdoor shade temperatures would not allow of the development of *P. falciparum* in the Anopheline, but it is presumed that the completion of the cycle is made possible because the mosquito spends practically all its life indoors, where the temperature is 5–10°F. higher than outside. It is probable that *A. gambiae* is reintroduced each year by road or rail transport. In 1943 and 1944, 63 examples were caught in trains arriving at Kisumu (75 miles from Londiani). The short outbreak of malaria on the farm in 1944 is explained by the assumption that gravid females of *A. gambiae* were introduced in March in motor vehicles coming from a malarious valley 20 miles below, and that their offspring emerged at the beginning of April, fed on African gametocyte carriers, became infective about 13th May and had died by about 27th May.

Papers noticed by Title only.

Bequaert (J.). **Cutaneous Myiasis** [in a man] **due to** *Cuterebra* [*buccata*, F.] **in Massachusetts.**—*Psyche* **52** no. 3–4 pp. 175–176. Cambridge, Mass. [1946.]

Laing (F.). **The Cockroach. Its Life-history and how to deal with it.**—*Econ. Ser. Brit. Mus.* (*Nat. Hist.*) no. 12 (4th edn.), 28 pp., 13 figs. London, 1946. Price 6*d*. [*Cf. R.A.E.*, B **26** 253.]

PESSÔA (S. B.). **Parasitologia médica.** [Medical Parasitology.]—$9\frac{1}{4} \times 6\frac{1}{2}$ ins., [9+]858 pp., 1 col. pl., 367 figs., 4 fldg., tables, 1 diagr., many refs. São Paulo, Editora Renascença S.A., 1946.

This practical handbook for medical students consists of a general introduction, three main sections on protozoology, helminthology and entomology, notes on various laboratory techniques and a bibliography. It has special reference to Brazil but is not restricted to it. The sections on protozoology and helminthology include notes on the vectors of pathogenic organisms that are transmitted to man by insects, and that on entomology (pp. 577–805) contains chapters on various groups of Arthropods of medical importance, over half of it being devoted to Diptera.

TENDEIRO (J.). **Tripanosomíases animais da Guiné Portuguesa.** [Trypanosome Diseases of Animals in Portuguese Guinea.]—*Bol. cultural Guiné port.* no. 5 pp. 111–172, 8 figs., 73 refs. [Lourenço Marques] 1947.

It is stated in the first part of this paper that trypanosome diseases are thought to be responsible for considerable losses and a general lowering of vitality among domestic animals in Portuguese Guinea, and that cattle and horses cannot be kept in some tracts of country in which *Glossina* spp. are particularly numerous. The species concerned are *G. palpalis*, R.-D., which occurs in areas having a heavy rainfall and a short dry season, and is common in mango groves alongside water-courses, *G. morsitans submorsitans*, Newst., which inhabits dry regions such as the inland plains, *G. longipalpis*, Wied., which prefers an intermediate climate, and *G. fusca*, Wlk., which is a forest species. The first three are known to transmit trypanosomes of the groups of *Trypanosoma vivax*, *T. congolense* and *T. brucei*. In 1932, trypanosomes of the *congolense* and *vivax* groups were found in sheep and goats in Portuguese Guinea, and those of the *congolense* and *brucei* groups in cattle and a horse, respectively. It is not known to what extent other blood-sucking Diptera are responsible for mechanical transmission, but those identified in Portuguese Guinea include several that have been thought to transmit trypanosomes elsewhere.

The rest of this part consists of an account of the climate, geology and hydrography of Portuguese Guinea, together with a list of the wild animals found there, with particular reference to those capable of influencing the spread of trypanosome diseases, either by acting as reservoirs or by serving as hosts of *Glossina*, another of the known or suspected insect vectors and a discussion of the local flora.

In the second part it is recorded that *T. theileri* was present in blood smears from two of a number of calves in Portuguese Guinea suffering from turning sickness [*cf. R.A.E.*, B **24** 155 ; **30** 57], which were examined in 1945. The literature on this trypanosome is reviewed and the forms observed are described ; it was not thought to be responsible for the condition, since it was not present in all the animals.

TENDEIRO (J.). **Estudo preliminar dos tabanídeos da Guiné Portuguesa.** [A preliminary Study of the Tabanids of Portuguese Guinea.]—*Bol. cultural Guiné port.* no. 6 pp. 435–447, 8 pls., 8 refs. [Lourenço Marques] 1947.

A list is given of 14 species of Tabanids, comprising nine of *Tabanus*, two of *Chrysops* and three of *Haematopota*, taken in recent surveys in Portuguese Guinea, together with notes on the morphology of the adults and references to the literature on the relation of some of them to diseases of man or animals in other parts of Africa.

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TENDEIRO (J.). **Ixodídeos da Guiné Portuguesa.** *Rhipicephalus simus* **Koch 1844 e** *Rhipicephalus sanguineus* **(Latreille 1806).** [Ixodids of Portuguese Guinea. *R. simus* and *R. sanguineus*.]—*Bol. cultural Guiné port.* no. 3 pp. 397–423, 6 figs., 9 refs. [Lourenço Marques] 1946. . . . **Sub-família Amblyomminae Neveu-Lemaire 1938.**—*Op. cit.* no. 7 pp. 617–709, 12 pls., 8 figs., 5 maps, 22 refs. 1947.

In these two papers, the author discusses, from observations and from the literature, the history, synonymy, geographical distribution, bionomics and relation to disease in man and animals where known, of *Rhipicephalus simus*, Koch, *R. sanguineus*, Latr., *Amblyomma paulopunctatum*, Neum., *A. variegatum*, F., *A. splendidum*, Gieb., *Haemaphysalis leachi*, Aud., and *H. hoodi*, Warb. & Nutt., all of which have been taken in Portuguese Guinea. The adults of both sexes of all of them are described, and the larvae and nymphs of some. Keys are given to the two species of *Haemaphysalis* and the three species of *Amblyomma*, and the distribution within the African continent of these five species is shown on maps. The two species of *Rhipicephalus* and *A. variegatum* were taken in Portuguese Guinea on various domestic animals, *H. hoodi* on fowls and all the rest on wild animals, though *H. leachi* was also taken on dog. *R. simus* was found together with *A. variegatum* and *Boophilus* (*Palpoboophilus*) *decoloratus*, Koch, on cattle infected by *Piroplasma* (*Babesia*) *bigeminum* and *Anaplasma marginale*. An instance is recorded of high mortality among a flock of 24 sheep in Portuguese Guinea, only two of which survived, due to *Rickettsia ruminantium*, which is transmitted by *Amblyomma variegatum*.

TENDEIRO (J.). **O** *Anaplasma marginale* **Theiler 1910 na Guiné Portuguesa.** [*A. marginale* in Portuguese Guinea.]—*Rev. Med. vet.* **41** no. 317 repr. 38 pp., 65 refs. Lisbon, 1946.

Anaplasma marginale, which is widespread in cattle in Portuguese Guinea, was observed there by the author in 1944, in blood smears from sick calves. An account is given, mainly from the literature, of its history, synonymy, morphology and geographical distribution, and of the symptoms, method of diagnosis, treatment and prevention of the disease to which it gives rise. Of its recorded tick vectors, *Boophilus* (*Palpoboophilus*) *decoloratus*, Koch, *Rhipicephalus simus*, Koch, and *R. sanguineus*, Latr., are common in Portuguese Guinea.

ROBERTS (F. H. S.). **Ticks infesting domestic Animals in Queensland.**—*Qd agric. J.* **64** pt. 4 pp. 233–244, 25 figs. Brisbane, 1947.

A brief general account of the morphology and life-history of ticks and their relation to disease is followed by notes on the morphology, distribution, hosts and importance of the commoner species on man, domestic animals and poultry in Queensland. These include, in addition to some of those dealt with in an earlier paper [*R.A.E.*, B **22** 115], *Ornithodoros gurneyi*, Warb. [**27** 249], a well-known tick in western Queensland, where it is fairly common in the soil and among débris under trees and in caves. Kangaroos are thought to be its chief hosts, but it also attacks man and dogs and probably other domestic animals.

Argas persicus, Oken, transmits spirochaetosis [*Spirochaeta anserina*] of poultry. Ticks frequently found on cattle include *Ixodes holocyclus*, Neum. [*cf.* **30** 28], *Haemaphysalis bispinosa*, Neum. [**27** 249 ; **31** 204], *H. bancrofti*, Warb. & Nutt., *Amblyomma triguttatum*, Koch, and *Boophilus annulatus microplus*, Can. The last, which is the most important, is a vector of two forms of

bovine piroplasmosis [*Piroplasma argentinum* and *P. bigeminum*] and anaplasmosis [*Anaplasma marginale*] [*cf.* **24** 121 ; **31** 29, 122]. It is common in Queensland on cattle and horses, readily attacks sheep, and has been recorded once each from pig, dog, wallaby and kangaroo. Deer (*Cervus elaphus*) may be heavily infested by it and will be a problem if its eradication is attempted. Under the system of cattle-tick control in Queensland, it is often important to know about how long an individual tick of any particular stage may have been attached. The figures in days for these periods, given by L. F. Hitchcock, are 3·5–8, 5–19 and 13·5–21 for unengorged larvae, nymphs and adults, and 4–9, 11–20, and 18·5–35 for engorged ones [*cf.* **33** 152]. The differential characters of six species of ticks commonly found on domestic animals and the kinds they attack are shown in a table. They comprise the five Ixodids mentioned above and *Rhipicephalus sanguineus*, Latr., which is very common on dogs and is occasionally found on cats, cattle, horses and sheep.

Morrison (F. O.). **Comparing the Toxicity of synthetic organic Compounds.**—*76th Rep. ent. Soc. Ont. 1945* pp. 18–20, 12 refs. Toronto, 1946.

Since DDT and related compounds act largely, and especially as regards flies, by virtue of a lethal residue on a surface and any comparative method of testing their efficiency must be capable of reproducing accurately and day after day extremely dilute dosages, known laboratory testing methods have proved inadequate. A new one that has given good results is here described. Filter papers 1·25×2 ins. are immersed in alcohol or acetone solutions of the materials under test, dried on a frame covered with clean unbleached cotton and stored in a cupboard until required. Control papers are impregnated with 95 per cent. ethyl alcohol alone. The papers are used to line small shell vials, ten for each dosage, and each vial is stocked with 15 adults of *Drosophila melanogaster*, Mg., 4–5 days old, and plugged with absorbent cotton wrung out in a 5 per cent. molasses solution. All concentrations of all materials are tested on one day, 5–12 dosages of each material are used, and the whole experiment is repeated on 8–10 different days. Mortality counts are made after 24 hours, when total mortality has reached a maximum and mortality in the controls has not begun. The results may be affected by loss of activity from the sprayed surface and fumigant effects, and possibly by the nature of the crystals deposited by solutions of different strengths.

Hall (A. R.). **Military Methods of Mosquito Control used during the Italian Campaign.**—*76th Rep. ent. Soc. Ont. 1945* p. 38. Toronto, 1946.

During the Italian campaign in 1944, the author was attached to a British Malaria Field Laboratory responsible for ascertaining the prevalence of malaria and Anophelines in newly occupied areas and the control measures necessary. The Anophelines found were *Anopheles claviger*, Mg., *A. superpictus*, Grassi, and six varieties of *A. maculipennis*, Mg. They were identified by allowing females collected in stables and houses to oviposit on moist filter paper in vials and studying the eggs. The control measures were the responsibility of other units, but experiments were carried out with bombs containing Paris green and discharged from four-inch mortars to control Anopheline breeding in craters in heavily bombed areas inaccessible to vehicles and too small to warrant aeroplane dusting. The bombs were timed to explode about 10 ft. above the target and discharged a cloud of Paris green that would cover an average shell hole. The mortar had a range of about half a mile and could be aimed with sufficient accuracy.

WISHART (G.) & JAMES (H. G.). **Notes on the Anopheline Mosquitoes of the Kingston, Trenton and Peterborough, Ontario, Areas.**—*76th Rep. ent. Soc. Ont. 1945* pp. 39–48, 3 maps, 2 refs. Toronto, 1946.

An account is given of the methods used in making surveys of Anopheline larvae and adults around hospitals at three service installations in Ontario in 1944 and 1945. The four Anophelines recorded from eastern Canada [*R.A.E.*, B **35** 47] were all taken in each of the areas. *Anopheles quadrimaculatus*, Say, was by far the most abundant species in 1944 in the two areas surveyed in that year, but *A. punctipennis*, Say, was almost equally plentiful in 1945. The reason for this is not known.

Comparison of the adult collections in natural resting places and nail kegs [**31** 52] with those in light-traps indicated that light-traps provide a good method of sampling for *A. walkeri*, Theo., fair for *A. punctipennis* and *A. maculipennis occidentalis*, D. & K., and very poor for *A. quadrimaculatus*. As the last is the only known vector of malaria in eastern Canada, light-traps would not appear to be reliable for making surveys of malaria vectors.

[MOSHKOVSKIĬ (Sh. D.).] **Мошковский (Ш. Д.). On the Relation between Temperature and the Rate of Development of the Malaria Plasmodia in the Mosquito. Communication I.** [*In Russian.*]—*Med. Parasitol.* **15** no. 6 pp. 19–28, 5 graphs, 13 refs. Moscow, 1946.

In the light of data from the literature, the author discusses the effect of temperature on the development of *Plasmodium* spp. in their Anopheline vectors. The following is largely based on his conclusions.

The rapidity with which *P. vivax*, *P. falciparum* and *P. malariae* complete their development within an Anopheline, as measured by the proportion of development completed in a day, shows an approximately linear relation to temperature over a considerable portion of that part of the scale at which development occurs, thus obeying the law of the sum of effective temperatures [*R.A.E.*, A **23** 296] and indicating a hyperbolic relation between duration of development and temperature. The position of the line for a given species is determined by the threshold of development, which was found by extrapolation to be 14·5°C. [58·1°F.] for *P. vivax* and 16°C. [60·8°F.] for *P. falciparum*, and the angle it makes with the abscissa, of which the tangent is about 0·95 for *P. vivax* and 0·9 for *P. falciparum*, and also by the maximum rapidity of development (0·125 of complete development per day for *P. falciparum* and 0·153 for *P. vivax*). The tangent of the angle for *P. malariae* could not be defined from the available data.

When the times required by *Anopheles maculipennis*, Mg. [var. *messeae*, Flni.] to digest a blood-meal at various temperatures and a relative humidity of 70–80 per cent., taken from a paper already noticed [B **27** 174], were plotted in the same way, it was observed that the threshold was lower (9·9°C. [49·82°F.]) and the tangent of the angle much greater (2·14) than for the development of *Plasmodium*.

[ZAIKIN (N. G.).] **Заикин (Н. Г.). Fifteen Years phenological Observations on the Malaria Mosquitos of the Town of Penza.** [*In Russian.*]—*Med. Parasitol.* **15** no. 6 pp. 28–32, 1 graph. Moscow, 1946.

Observations from 1924 to 1938 in the Province of Penza (central Russia) showed that the only two species of *Anopheles* there are *A. claviger*, Mg. (*bifurcatus*, auct.), which is uncommon, and *A. maculipennis*, Mg., (represented by vars. *messeae*, Flni., and *typicus*), which is widely distributed and so of importance as a vector of malaria.

Activity of the overwintered females began as soon as the mean daily temperature was over 1°C. [33·8°F.] and the minimum about 0°C. [32°F.], the earliest date on which females containing blood were taken in animal quarters ranging from 23rd March, in 1938, to 30th April, in 1929. They were most numerous in 1935 between the end of April and the middle of May, but some lived till about mid-June. The earliest and latest dates on which larvae were first observed were 23rd April, in 1935, and 21st May, in 1929, and those on which the first adults of the new generation emerged were 23rd May, in 1932, and 4th June, in 1933. The period from the first feeding by overwintered females to the first emergence of new adults varied from 30 days in 1932 to 58 in 1935, and the temperature of the water at the end of it was usually about 20–21°C. [68–69·8°F.], with a maximum of 29°C. [84·2°F.] in the sites most exposed to the sun. The first-generation adults emerged throughout June and part of July, three or four generations were completed during the season, and some adults emerged as late as October. In October 1924, larvae taken outdoors in ice revived if the ice was melted slowly, indicating that they can withstand temporary freezing and give rise to adults in quite late autumn. The first females with a developed fat-body were taken on 12th August in 1937 and mass hibernation began in September, though individuals containing blood and eggs persisted until the end of the month, and one with fully developed eggs was taken in a flat on 11th November. The period during which feeding occurs thus extends from April to October in animal quarters and to November in houses. Most of the mosquitos hibernated near breeding sites; basements of inhabited houses were preferred, followed by animal quarters, lumber rooms, and cellars. Since mosquitos that overwinter near dwellings are likely to enter them in spring to feed and the temperature in April–June is high enough to allow the development of sporozoites in them, it is possible for malaria to be transmitted from the end of June.

[Suirevich-Boronenkova (A. S.) & Zakhar'yantz (N. A.).] **Сыревич-Бороненкова (А. С.) и Захарьянц (Н. А.). On the Phenology of** *Anopheles* **in the Kokand District of the Uzbek SSR.** [*In Russian.*]—*Med. Parasitol.* **15** no. 6 pp. 33–39, 1 graph. Moscow, 1946.

Of the Anophelines found in day-time shelters or hibernation quarters (chiefly stables) in the Kokand district of eastern Uzbekistan in April–November 1942 and throughout 1943, *Anopheles maculipennis* var. *sacharovi*, Favr, and *A. superpictus*, Grassi, were the most numerous, *A. pulcherrimus*, Theo., came next in abundance, *A. claviger*, Mg. (*bifurcatus*, auct.), was scarce, and *A. hyrcanus*, Pall., was represented by only three examples.

Overwintering females of *A. m. sacharovi* and *A. superpictus* were most numerous in animal quarters and barns and were also found in inhabited houses. Examples of both species containing blood were taken as early as 26th February at a mean ten-day temperature of 6·8°C. [44·24°F.]; those dissected on 12th March had ovaries in the third or fourth stage of Christophers [*R.A.E.*, B **29** 93]. In the case of *A. m. sacharovi* oviposition apparently began at the end of March and reached a maximum in mid-April. In both years first-generation adults appeared at the end of April, with the peak of emergence in mid-May, and second-generation larvae became abundant in the second half of May. Owing to the dying off of the overwintered females, the adult population fell off at the end of April, but it reached its highest point in May, sharply decreasing in June and July, when the mean monthly temperatures (25–26°C. [77–78·8°F.] and 28–29°C. [82·4–84·2°F.]) exceeded the optimum for this Anopheline. The decline in temperature in August was accompanied by a second rise in its abundance with a small peak in October. A few larvae of *A. superpictus*, which requires higher temperatures than *A. m. sacharovi*,

appeared in April and May, but the first-generation adults did not emerge until about three weeks after those of *A. m. sacharovi*. The adult population was at its lowest in May, increased thereafter until the end of June, fell off slightly in July and then again increased, the peak of abundance in the shelters being reached in November. Adults of *A. pulcherrimus*, which is another heat-loving species, were taken only from June to October and were most numerous in July or August. It is not known where this species hibernates in Kokand [*cf. R.A.E.*, B **1** 195] ; larvae were found only in July–September, with a maximum in August.

Pupae of *A. claviger* were first found early in March and adults were common in day-time shelters in April, scarce in May and June, absent in July and August, and present in small numbers again in September and October.

[Maslov (A. V.).] **Маслов (A. B.). Variability and Systematics of** *Anopheles hyrcanus* **Pallas, 1771.** [*In Russian.*]—*Med. Parasitol.* **15** no. 6 pp. 39–46, 11 refs. Moscow, 1946.

The wide distribution and variable characters of *Anopheles hyrcanus*, Pall., have led to the description of numerous subspecies and varieties of this Anopheline and also of several species that were thought to be distinct. Some of these forms have since been recognised as synonyms, but in view of the large number remaining, a study of the complex was begun in 1930. Several thousand specimens from the Russian Far East and Central Asia were examined and compared with material from the Caucasus, the Ukraine and countries outside the Soviet Union, and data in the literature were also considered. It appeared that wide variations existed in the general dimensions of the body, the size of the palps, wings, wing veins, legs and leg segments, and the proportions of one part of the body to another.

The differences observed in the coloration of the body are discussed, and five different types of markings on the palps, eight types on the wings [*cf. R.A.E.*, B **20** 155] and six types on the hind tarsi are described. Each corresponds to some described form, but examples differing in the marking of the palps have been reared from larvae taken in the same breeding place and from single batches of eggs. All the five types of palps, seven types of wings and four types of tarsi were observed in mosquitos from the Russian Far East, though their frequency varied in different districts, and three, four and three types, respectively, in material from Central Asia.

Disregarding forms that have been described from the immature stages, the author proposes to retain only two varieties (subspecies) of *A. hyrcanus*, namely, the typical one and var. *sinensis*, Wied., distinguished morphologically by wing markings, though they are better separated on a basis of geographical distribution and habits. Var. *hyrcanus* is restricted to the Palaearctic region, but does not occur in the Manchuro-Chinese subregion, and is mostly exophilous, so that it is of little importance as a vector of malaria, whereas var. *sinensis* occurs in the Manchuro-Chinese subregion of the Palaearctic, throughout the Oriental region, and in the Australasian region, and is largely endophilous, so that it is an important vector in some places (Indo-China, the Malay Archipelago and Japan) and of potential importance in the south of the Russian Far East.

Lists are given of the synonyms of each of these varieties, and some of them are discussed. Among those commonly considered as distinct varieties, *A. h. nigerrimus*, Giles, is thought to be only a colour form of var. *sinensis*, since there are many transitional forms between them and no geographical or ecological differentiation, and var. *pseudopictus*, Grassi, is considered only a colour form of var. *hyrcanus*. The view that var. *mesopotamiae*, Chr. & K. C. [**3** 212] is only a seasonal form of var. *hyrcanus* [**20** 155 ; **23** 47] is confirmed ; examples of it were observed throughout the area of distribution of var. *hyrcanus* and

similar ones occurred in that of var. *sinensis* in the Far East. *A. chodukini*, Mart. [**19** 24] and *A. edwardsi*, Yam. [**14** 13] are colour forms of vars. *hyrcanus* and *sinensis*, respectively. The other synonyms of var. *hyrcanus* are *A. h. marzinovskii*, Shing. [**14** 129], *A. pictus*, Lw., *A. pseudopictus* var. *flerowi*, Portsch., *A. hyrcanus* var. *mahmuti*, Mart. [**19** 24] and *A. popovi*, Shing. [**16** 200].

[Dolmatova (A. V.).] **Долматова (А. В.). On the Biology of Sandflies inhabiting Burrows.** [*In Russian.*]—*Med. Parasitol.* **15** no. 6 pp. 47–55, 3 figs. Moscow, 1946.

As it has been shown that sandflies that inhabit the burrows of wild animals are of importance in the dissemination of cutaneous leishmaniasis in Turkmenistan [*cf. R.A.E.*, B **24** 179; **32** 172; **34** 77], sandflies entering or leaving burrows in a district in south-eastern Georgia where leishmaniasis is not common were trapped between 1st July and 15th September 1945. Most of the burrows were occupied by birds, tortoises or toads and some were empty; they were on mountain slopes, the banks of streams and the sides of ravines. The sandflies trapped comprised *Phlebotomus papatasii*, Scop., *P. perniciosus* var. *tobbi*, Adl. & Thdr., *P. sergenti*, Parr., *P. chinensis*, Newst., *P. kandelakii*, Shchur., *P. perfiliewi* var. *transcaucasicus*, Perfil'ev, *P. dentatus*, Sinton (*minutus* var. *arpaklensis*, Perfil'ev) and *P. sergenti* var. *mongolensis*, Sinton. The first five of these, in order of decreasing frequency, also occurred in houses, but *P. dentatus* and *P. perniciosus* var. *tobbi* were the predominant sandflies in the burrows before and after mid-August, respectively, *P. sergenti* was not numerous, and the others were rare. *P. p. tobbi* and *P. sergenti* attacked man in the open, but *P. dentatus* did not.

The sandflies left the burrows at dusk and entered them after darkness had fallen. Their exit was apparently stimulated by twilight and not by temperature or humidity, but it was prevented by windy or rainy weather. Dissection of 608 females of *P. dentatus*, *P. perniciosus* var. *tobbi* and *P. sergenti* taken while leaving the burrows showed that ovarian development was related to blood digestion [*cf.* **32** 50] in all three species; 91·6, 63·4 and 64·9 per cent., respectively, contained no blood, and these comprised both newly emerged females and females that had oviposited. Females containing no blood, but of which some had oviposited, comprised 48·6 per cent. of those from inhabited burrows and 81 per cent. of those from uninhabited ones. The large percentage of females of *P. dentatus* that leave the burrows in a hungry condition indicates that most individuals with mature eggs remain in the burrows to oviposit. Of females of *P. dentatus* taken while entering burrows, 93·6 per cent. were hungry. In these observations, the physiological age of the females was assessed by the presence or absence of secretion in the lubricating glands (sebaceous glands of Adler & Theodor [**23** 122]) and the appearance of the ovaries, the ovarioles remaining stretched for some time after oviposition, but in some cases only one of these criteria could be used since the secretion is ultimately exhausted and the ovarioles resume their normal appearance if feeding is delayed.

[Pospelova-Shtrom (M. V.).] **Поспелова-Штром (М. В.). On the Ecology of *Alectorobius cholodkovskyi* (Pavlovsky, 1930) (Ornithodorinae).** [*In Russian.*]—*Med. Parasitol.* **15** no. 6 pp. 55–59, 10 refs. Moscow, 1946.

Details are given of the conditions under which nymphs and adults of *Ornithodoros* (*Alectorobius*) *cholodkovskyi*, Pavl. [*cf. R.A.E.*, B **18** 216], were found in two extensive caves in southern Turkmenistan in 1935 and again in August 1940. The caves were at altitudes of about 1,400 and 1,600 ft., and the temperatures in them varied from 24 to 27°C. [75·2–80·6°F.]. One of the caves was inhabited by bats (chiefly *Rhinolophus bocharicus*), and the ticks

congregated in the parts actually occupied by the bats; examples taken in these places were replete or contained semi-digested blood. Members of the surveying party who spent several hours lying on the floor of the cave in search of ticks were not attacked. The ticks occurred in cracks and depressions in the walls and were common near the floor and in the droppings of the bats and other débris on it. Only a single bat was found in the other cave in 1935 and none in 1940. The ticks were not numerous there and must have existed by feeding on occasional hosts. They were found all over the parts surveyed, were either semi-replete or unfed, and readily attacked man.

No relapsing-fever spirochaetes could be isolated from ticks from either of the caves, but spirochaetes were found by Latuishev to be present in bats taken from one of them in 1934 [*cf.* **31** 59] and by the author in one out of the ten bats taken there in 1940. Two workers contracted the disease in 1935 after having visited this cave, and *O. cholodkovskyi* must have been the vector since no other ectoparasites occurred on the bats.

[Grobov (A. G.).] **Гробов (А. Г.). On the Question of Carriers of the Crimean haemorrhagic Fever.** [*In Russian.*]—*Med. Parasitol.* **15** no. 6 pp. 59–63, 2 refs. Moscow, 1946.

Epidemics of haemorrhagic fever with a large percentage of fatal cases occurred in the Crimea in the summers of 1944 and 1945, particularly in several steppe districts in the west and in the Kerch peninsula. It was found to be caused by a virus transmitted by *Hyalomma marginatum*, Koch. This was the only tick observed in the steppe districts in summer, though *Haemaphysalis* and *Dermacentor* were taken in early spring and late autumn; it was commonest at the beginning of July, particularly on hard ground near hay-ricks and straw stacks, on waste land covered with grasses, and in places frequented by cattle. It constituted 87·4 per cent. of the ticks collected in September 1944 in the Kerch peninsula, the others, in order of decreasing frequency being *Haemaphysalis cinnabarina punctata*, C. & F., *Dermacentor marginatus*, Sulz., and *Rhipicephalus sanguineus*, Latr. In November, however, *Haemaphysalis* and *Dermacentor* predominated, and only single examples of *Hyalomma* could be found.

In a search for the host of the immature stages, larvae and nymphs of *H. marginatum* were commonly found on hares (*Lepus europaeus transsylvanicus*), but occurred on no other mammals, and were occasionally taken on birds, including nymphs on fowls; they are known not to attack cattle, horses or man. Larvae and nymphs taken between mid-June and mid-July were in a semi-starved condition, but those taken from August to October were fully fed. The engorged nymphs drop from the hares in autumn and hibernate, and this explains the occurrence of ticks near hay-ricks and in places in which the ground is hard, where the hares shelter in rainy weather. In spring, the nymphs transform to adults, and these attack cattle, sheep, horses and man. The virus was isolated from unfed adults of *H. marginatum* collected in the steppe, and again from nymphs taken on hares, but not from those taken on birds.

[Tiflov (V. E.).] **Тифлов (В. Е.). Detection of Plague Infection in Nature by Examinations of Fleas.** [*In Russian.*]—*Med. Parasitol.* **15** no. 6 pp. 69–75, 12 refs. Moscow, 1946.

Investigations on the diagnosis of plague infection in fleas are briefly reviewed [*cf. R.A.E.*, B **17** 131; **21** 5], and an account is given of experiments on the subject in the northern Caucasus. The fleas used were *Ceratophyllus consimilis*, Wagn., and *Ctenophthalmus wagneri*, Tiflov, which gave equally good results, and suspensions were prepared by pounding batches of 25, 50, 75, or 100 fleas

in a few drops of normal saline, subsequently made up to 0·4–1·8 cc. Each batch contained one infected flea, and since killing the fleas with chloroform or ether is detrimental to the plague bacilli [*cf.* **28** 28], only living fleas were used to prepare the suspensions.

Part of each suspension was cultured on agar and the remainder injected intramuscularly into a guineapig. The results are discussed and summarised in a table and showed that infection can be detected even if only one infected flea is present in 100. Positive results were obtained with 39 of 40 suspensions tested by injection, the guineapigs dying within 3–7 days, with 33 of 39 suspensions sown on ordinary agar, and with 37 of 39 sown on blood agar. The culture method was thus slightly less reliable, but it was also slightly more rapid, since results were obtained in 1–2 days.

Excreta collected during periods of 12–108 days from *Ceratophyllus consimilis* were sown on agar, but plague bacilli were only observed in 50·3 per cent. of the cultures, though dissection of the fleas after death showed that bacilli were present in the digestive tract of all of them. In the experiments of Golov & Ioff [**14** 66], infected fleas sometimes discharged excreta that were free from bacilli, and the author calculates that 33·4 per cent. of the samples obtained by them from four examples of *C. tesquorum*, Wagn., contained none. He concludes, therefore, that the absence of plague bacilli in the excreta of a flea does not prove their absence in the digestive tract.

[Vaĭnberg (—) & Krasil'shchikov (—).] **Райнберг (—) и Красильщиков (—). Results of the Use of Thiodiphenylamine as a Larvicide.** [*In Russian.*]—*Med. Parasitol.* **15** no. 6 pp. 75–77. Moscow, 1946.

In field tests in Bessarabia in 1946, dusts containing phenothiazine (thiodiphenylamine) gave complete mortality of Anopheline larvae of all instars in 12 hours and proved a good substitute for Paris green. It was found that a rate of 0·45–0·9 lb. phenothiazine per acre, according to the density of the vegetation, was sufficient when applications were made from an aeroplane and 0·9–1·35 lb. when they were made from the ground. Ash, road dust and talc all proved good diluents, and effective dilutions were 1 : 1 for applications from the air, 1 : 19 for hand-dusting apparatus and 1 : 100 for broadcasting by hand. No injury to vegetation and no instances of the poisoning of cattle, of fish in ponds that were treated repeatedly, or of bees within the dusted areas were observed. Slight irritation of the skin and eyes was experienced by the operators, though the mouth and nose were protected by muslin and the eyes by goggles, but it disappeared in 2–3 days.

Drawbacks to the use of phenothiazine were the formation of lumps in the packed material and the increased cost of dusting from an aeroplane as compared with Paris green, which is less bulky. Owing to its low specific gravity, phenothiazine always floats on the water; it cannot mix with it in the form of a suspension and so is ineffective against larvae of *Culex* and *Aëdes* [but *cf.* **31** 161; **34** 182]. Symptoms of poisoning were observed in a goat, a calf, a cat and a dog after 0·5 and 3 gm. phenothiazine had been added to their food, on two successive days, and severe symptoms when 15 gm. was subsequently administered to a cat and a dog, but all eventually recovered.

Klechetova (A. M.).] **Клечетова (А. М.). Hexachlorethane as an Insecticide for the Destruction of the Larvae of Flies.** [*In Russian.*]—*Med. Parasitol.* **15** no. 6 pp. 77–81, 1 graph. Moscow, 1946.

Since large amounts of chlorinated aliphatic hydrocarbons are available in Russia, experiments were carried out to determine whether they are of use against the larvae of flies.

In preliminary tests of polychlorethanes containing 2–6 chlorine atoms, batches of 30 larvae of *Musca domestica*, L., in the third instar (which is the most resistant) were introduced into tumblers containing 100 gm. fresh horse manure, moist bran or soil, and 0·25–2 gm. or cc. of the substance under test was then added. The percentage mortality after 48 hours was 100 for all dosages of tetra- and pentachlorethane, but the other compounds were less effective. Hexachlorethane [*cf. R.A.E.*, B **24** 128] gave only 91 per cent. mortality at the highest dose, but since it is only slightly toxic to warm-blooded animals and, being a powder, is easy to transport, it was selected for further investigation. Its relatively low effectiveness was found to be due to its insolubility in water, contact with a moist medium causing it to coagulate and preventing rapid evaporation. It gave much higher mortality (sometimes 98–100 per cent.) when it was thoroughly mixed with the medium, instead of being applied to the surface only, and mortality was also high when manure or moist bran in boxes was treated in layers up to about 5 ins. thick with 1 per cent. of its weight of hexachlorethane at a temperature of 22·5°C. [72·5°F.]. In tests with adult flies, the odour of hexachlorethane repelled 55 per cent., as compared with 10 per cent. for chloride of lime. When three outdoor refuse boxes in constant use were treated daily with finely ground hexachlorethane at the rate of 6 oz. per 1–2 sq. yds. of surface, the numbers of flies that emerged were considerably smaller than from untreated boxes. In 1945, hexachlorethane was tested on a large scale for the control of flies in Moscow, and good results were obtained in five out of the seven sections of the city in which it was used.

[Dolinskaya (T. Yu.), Klechetova (A. M.) & Tregubov (A. N.).] **Долинская (Т. Ю.), Клечетова (А. М.) и Трегубов (А. Н.). The Use of Chloride of Lime for the Control of Flies.** [*In Russian.*]—*Med. Parasitol.* **15** no. 6 pp. 81–82. Moscow, 1946.

A summary is given of the results of experiments carried out in Moscow in which chloride of lime was used against the flies breeding in dung or latrines. A 15 per cent. solution poured over dung at a rate of 1 pint to 2½ lb. killed 58 per cent. of the eggs and 20 and 25 per cent. solutions killed 60–80 per cent. of the larvae in 2–3 days. When immersed in it for 30 minutes, all eggs were killed by a 15 per cent. solution, but only 10 per cent. of third-instar larvae by a 20 per cent. solution. A 10 per cent. solution was ineffective both when applied to the dung and in immersion tests. The best results in latrines were obtained by dusting the liquid contents with dry chloride of lime until a compact film was formed on the surface, all larvae being killed if the treatment was carried out twice a week. The amount used averaged 30 oz. per sq. yd. of surface, but the first application required much more than subsequent ones, and the essential condition was the formation of an unbroken film.

Chloride of lime was repellent to adult flies, but the consequent reduction in the numbers of larvae was substantial only at rates of not less than about 20 oz. per sq. yd.

Brescia (F.). **Salt Marsh and Anopheline Mosquito Control by Ground Dispersal of DDT Aerosols.**—*J. econ. Ent.* **39** no. 6 pp. 698–715, 3 figs., 2 refs. Menasha, Wis., 1946.

Details are given of field tests in Florida and Alabama in 1944 on the practicability of using stable aerosols, composed of droplets of oil containing DDT, dispersed from a ground vehicle or a boat for the rapid control of mosquitos over large areas. The species numerous enough for significant tests were *Aëdes sollicitans*, Wlk., and *A. taeniorhynchus*, Wied., in Florida and *Anopheles quadrimaculatus*, Say, in Alabama. Mosquito movements are of two kinds,

diurnal movements within limited areas and irregular roving movements. The former determine when and where a certain group should be treated, and the latter affect the rate of infiltration into a treated area from outside.

In the generator used, an emulsion of water and oil containing the dissolved DDT is pumped through a vapourising coil to form a mixture of super-heated steam and liquid oil, which is then passed into the atmosphere through capillaries of specific dimensions at regulated temperatures and pressures; in later models a dual pump feeds the oil and water separately into the coil so that the need for emulsification is eliminated. The emulsion used was usually equal parts of oil and water by volume. The DDT was first dissolved in xylene to increase the rate of solution and the quantity that could be dissolved. The formula adopted was 40 parts by weight lubricating oil, 8 parts xylene, 4 parts DDT, 2 parts emulsifier and 46 parts water.

Early tests were made by generating the aerosol from a fixed point and determining the toxicity to caged insects at various distances down wind. Later, when natural populations were available, caged mosquitos were still used to prove that the aerosol was not simply repellent. When natural populations of larvae were not available, larvae in pans were exposed in the cages. It is concluded from the results obtained with various emulsions, dosages and particle sizes at different times of day and in different weather that 15 U.S. gals. per 1,000 ft. (distance covered by generator carrier) of an emulsion containing DDT equal to 10 per cent. of the weight of the oil will control adult mosquitos effectively for about a mile down wind in open country under favourable meteorological conditions and for about 1,000 ft. in forested areas. Inversion conditions (with the temperature of the air near the ground colder than that of the layers above) or at least neutral conditions are necessary and wind speeds above two miles per hour are desirable. Operations with wind speeds of less than 0·1 m.p.h. are not practicable. Atmospheric stability is satisfactory between sunset and sunrise. Proper meteorological conditions for operation were checked by setting off a hand smoke-grenade and observing the behaviour of the smoke cloud. In recommending a dosage of 15 U.S. gals. per 1,000 ft., it is assumed that for practical purposes the extent of control will be independent of wind velocity. This was confirmed later in wind tunnel experiments to be reported separately.

There is no prolonged lethal effect on adults from the recommended dosage. It is concluded from one experiment that to obtain prolonged control of adults of the salt-marsh mosquitos (*Aëdes sollicitans* and *A. taeniorhynchus*), it would be more practical to treat extensive areas for kill on the wing than to deposit sufficiently large quantities of DDT over limited areas to leave a toxic residue. Areas cleared of *Anopheles quadrimaculatus* remain free of infestation for several days because of the comparatively slow rate of infiltration of this species. Adults were killed in tree-holes, hollow logs and other natural resting places.

The same dosage will give practical control of larvae for about 2,000 ft. in open country and 500–1,000 ft. in forested areas. It did not harm fish in the waters of the test areas in Florida. Tests indicated that a local deposition of 0·002 lb. DDT per acre will kill 50 per cent. of larvae of *Aëdes sollicitans* and *A. taeniorhynchus* within 18 hours of treatment, and depositions of 0·001 lb. DDT will kill 95–100 per cent. of those of *Anopheles quadrimaculatus* within 12 hours.

Preliminary experiments begun in 1943 with *Drosophila* and quantitative studies on *Aëdes aegypti*, L., carried out jointly with R. Latta showed that particles 0·4–1 micron in diameter are relatively ineffective because of poor deposition on the insects. Particles more than 40 microns in diameter do not remain airborne for appreciable distances unless the wind speed is at least 15 miles per hour. Particles with a diameter of more than about 10 microns cannot penetrate forested or jungle areas appreciably. Best results against

adults in the field are obtained with particles 10 microns in diameter, regardless of wind speed or terrain. To control larvae in open country, particles with diameters of 16, 24 and 32 microns should be used at wind speeds of 1–3, 3–6 and 6–10 miles per hour, respectively. Mass average particle size was shown to be a function of a number of variables, including the volume ratio of steam to oil projected through the outlet nozzles and the viscosity and surface tension of the mixture of DDT and oil. A large proportion of steam, low viscosity and low surface tension all favour the formation of small particles. At proper operational temperature, the extent of DDT decomposition was negligible.

Horsfall (W. R.). **DDT used to control a Rice-field Mosquito,** *Psorophora confinnis.*—*J. econ. Ent.* **39** no. 6 pp. 723–725, 5 refs. Menasha, Wis., 1946.

The following is based on the author's summary of observations in Arkansas in 1946. The midsummer generation of *Psorophora confinnis*, Lynch, in rice-fields [*cf. R.A.E.*, B **31** 93] was controlled by using DDT in a dry mixture with a granulated nitrogenous fertiliser broadcast over the field immediately before the beginning of the second irrigation. No larvae were found in a field treated with 2 lb. DDT in 200 lb. of the fertiliser per acre or in plots treated with 0·5 lb. DDT in 150 lb. fertiliser per acre when the mean population in control areas was more than three larvae per sq. ft. DDT at 2 lb. per acre was lethal to fourth-instar larvae placed in a treated field one day after irrigation began, and nearly 70 per cent. of larvae in the third and fourth instars were killed when placed in the field four days after it had been irrigated. Water that had passed through a field treated with 2 lb. DDT per acre was not toxic to larvae when it was allowed to flood an untreated area. Larvae of *Anopheles quadrimaculatus*, Say [*cf.* **32** 158], were reduced to four per 20 sq. ft. 17 days after treatment of plots with 4 lb. DDT per acre, while control plots had 56 larvae per 20 sq. ft. Dytiscids, Hydrophilids and rice water weevils [*Lissorhoptrus simplex*, Say] seemed to be resistant to DDT at as much as 4 lb. per acre and frogs' eggs were resistant to at least 0·5 lb.

Travis (B. V.), Maple (J. D.), Hurlbut (H. S.) & Husman (C. N.). **Cub Airplanes in the South Pacific for Application of DDT.**—*J. econ. Ent.* **39** no. 6 pp. 726–728, 3 refs. Menasha, Wis., 1946.

Summaries are given of experiments made in Guadalcanal and Bougainville on the application of DDT from small (Cub) aeroplanes to control mosquito larvae. The spray equipment was the venturi apparatus developed by Husman & Longcoy [*R.A.E.*, B **34** 171]. The DDT was applied as a 5 per cent. solution in a mixture of equal parts of diesel oil and S.A.E. 10 lubricating oil, except in one test, which was made with an emulsion containing 5 per cent. DDT prepared from a concentrate comprised of 20 per cent. DDT, 20 per cent. Triton X-100 and 60 per cent. xylene. Adequate and frequently complete control of *Anopheles* (mostly *A. farauti*, Lav.), *Bironella* and *Culex annulirostris*, Skuse, always followed application of 2 U.S. quarts per acre regardless of the density of the vegetation, which varied from open grassland to extremely dense jungle. Over the wooded areas, it was sometimes necessary to fly as high as 175 ft. Natural obstacles and wind direction would often have made the use of larger and faster aircraft impracticable. *A. farauti* bred chiefly in road ruts, borrow pits, shell-holes and the like, and also in depressions in swampy areas and along the edges and at the mouths of streams blocked by sand bars. Many of these would have been very difficult to treat from the ground. Larvae hatching the day after treatment were usually not killed, so that weekly treatments were necessary. Several observations in areas where

adult *Aëdes* were present indicated that large reductions in their numbers were effected by the sprays.

YUILL (J. S.), DEONIER (C. C.), WISECUP (C. B.) & GIRDLER (G. W.). **Development of Spraying Apparatus for HNS-1 Helicopter.**—*J. econ. Ent.* **39** no. 6 pp. 729–734, 4 figs., 5 refs. Menasha, Wis., 1946.

Early work with autogiros showed that sprays could be controlled better than dusts when applied from the air and that slow-moving, rotary-wing aircraft were suitable for aerial spraying [*R.A.E.*, A **27** 645; **30** 355–356]. The possibility of using a helicopter for applying DDT sprays to control malaria-carrying Anophelines was investigated, using the HNS-1, which is briefly described. Since the flow of air about the helicopter varies with the air speed, it was felt that a pressure system would maintain a more uniform flow rate and atomisation than would an air venturi or other apparatus designed for fixed-wing aircraft, in which the air speed is more constant. An apparatus was developed for the HNS-1 that can disperse either oil solutions of DDT or water emulsions, provided that they are free of sediment, or in the case of emulsions, that the system is flushed and inspected frequently, because of the danger of damage to synthetic rubber by the solvent. The apparatus consists of a tank with a capacity of 30 U.S. gals., from which the spray liquid is carried by gravity through a strainer to a hydraulic pump, which is worked by the engine of the helicopter and so is in continuous operation during flight. From this, a discharge line leads to an adjustable relief valve and a selector valve. A by-pass line returns the excess liquid from the relief valve to the spray tank during spraying. A similar by-pass line from the selector valve to the tank enables the liquid to circulate at zero pressure when spray is not being dispersed. The maximum flow rate is 5·5 U.S. gals. per minute and the pressure ranges to 1,500 lb. per sq. in. Equipment using the exhaust gases to atomise the spray was not very satisfactory, as it produced a combined spray and smoke, which was somewhat inefficient owing to the loss of effective spray as smoke particles. Chief attention was therefore given to nozzles. Droplet sizes and discharge per minute obtained with various types are given in a table. On the basis of the results, attention was limited to three nozzles producing droplets in the lower portion of the range, in the upper portion and over a broad range of sizes, respectively.

An account is given of experiments in which the effective swathe width of the helicopter was estimated from the size of droplets settling on slides, the mortality among larvae of *Anopheles quadrimaculatus*, Say, exposed in containers and the time necessary to immobilise adult house-flies [*Musca domestica*, L.] placed in previously exposed dishes. Results are also given of tests to compare the performance of the helicopter with that of fixed-wing aircraft, in which relative efficiency depended on whether greater manoeuvrability and ability to land on a small area were the chief consideration or whether these advantages of the helicopter were offset by its lower cruising speed, smaller useful load and smaller swathe width. The purchase and operational costs of the helicopter are much higher than those of fixed-wing aircraft. It is concluded that the HNS-1 is satisfactory for experimental studies, as it can be fitted with special equipment for rapid change of spray mixtures and atomising apparatus to facilitate experimental procedure. It is not, however, recommended for routine control operations because of its low cruising speed, limited useful load, and inadequate power for operating under unfavourable conditions. Moreover, the airflow is such that a safe effective swathe width of only 60 ft. is produced. The greater manoeuvrability of helicopters suggests their use in many insect-control operations that could not be carried out with fixed-wing aircraft, including not only the dispersion of sprays but also reconnaissance and inspection of inaccessible areas.

Jones (H. A.) & Fluno (H. J.). **DDT-Xylene Emulsions for Use against Insects affecting Man.**—*J. econ. Ent.* **39** no. 6 pp. 735–740, 3 refs. Menasha, Wis, 1946..

The following is the authors' summary. The requirements are given of a DDT emulsion concentrate for use in the control of insects affecting the armed forces. The method of testing the physical stability of emulsions to be used for this purpose is described. Results are given of physical stability tests of over 100 emulsifiers tested for this use.

The emulsifier Triton X-100 (an aralkyl polyether alcohol) was finally selected to be used in combination with xylene as the solvent. As a result of tests of numerous proportions of DDT, emulsifiers, and solvent, a concentrate containing 25 per cent. DDT, 10 per cent. Triton X-100, and 65 per cent. xylene was recommended for military use. This formulation emulsifies, with a minimum amount of agitation, in distilled, hard, and sea water. It may be diluted to concentrations of from 0·1 to 10 per cent. of DDT to form reasonably stable emulsions. In this manner it may be used in the control of adult mosquitos, flies, and other insects ; as a mosquito larvicide ; and in the proofing of clothing against lice [*Pediculus humanus*, L.]

The DDT emulsion concentrate has become one of the important DDT formulations. Its concentrated form, ease of preparation, and ready application to a wide variety of situations have made it especially valuable to the armed forces.

Travis (B. V.) & Bohart (R. M.). **DDT to control Maggots in Latrines.**—*J. econ. Ent.* **39** no. 6 pp. 740–742, 3 refs. Menasha, Wis., 1946.

In field tests made in Okinawa in 1945, solutions of 4–5 per cent. DDT in diesel oil or kerosene applied at 1 U.S. quart per seat hole once a week controlled larvae of flies (principally *Chrysomyia megacephala*, F.) in the pits of latrines built and used according to military specifications. Daily spraying of the faecal mass in quantities to total about 1 U.S. quart insecticide per seat hole each week gave the most reliable results. If pits were shallow (3–5 ft. deep) or the boxes not fly-tight, or less than eight seat holes were provided per 100 men, weekly treatment was insufficient. DDT at 5 per cent. in emulsified xylene killed the maggots more rapidly than unemulsified solutions (inactivating full-grown ones in less than 12 hours and sometimes in less than one hour as against more than 24 hours), but it proved unsafe for use in latrines with deep pits and tight boxes as the xylene vapour exploded when a match was struck. The emulsions can, however, be used to control larvae not in enclosed spaces. The advantages of sodium arsenite, DDT and paradichlorbenzene for the control of fly breeding in latrines are compared. The sodium arsenite was used in the form of a 54 per cent. concentrate (Penite) and diluted, 1 : 40, with any kind of water for application. It is effective under nearly all conditions and requires very little shipping space, but is very toxic to man. DDT is more bulky but almost as effective, though sometimes it does not kill mature larvae quickly enough to stop them migrating from the pit. It is not very toxic to man and leaves a residue on the sides of the box and pit that will kill adult flies. Paradichlorbenzene is effective in deep dry unventilated pits and also prevents flies entering, but it is not completely effective under other conditions and is bulky.

McDuffie (W. C.), Lindquist (A. W.) & Madden (A. H.). **Control of Fly Larvae in simulated Pit Latrines and in Carcasses.**—*J. econ. Ent.* **39** no. 6 pp. 743–749, 2 refs. Menasha, Wis., 1946.

A study of the control of fly larvae was begun in Florida in 1945 in view of the importance of blowflies and *Musca domestica*, L., as carriers of dysentery

and as a source of annoyance to troops in the Pacific war zone. The following is almost entirely based on the authors' summary of the results. Paradichlorbenzene at 20 gm. per sq. ft. and orthodichlorbenzene at 25 ml. gave good kill of house-fly larvae when applied to the surface of the medium (usually oat hulls, lucerne meal or bran) in extensive tests in simulated pit latrines, and 15 gm. of the former and 15 ml. of the latter were satisfactory if followed by retreatment in 2–4 days. Both were highly effective ovicides, as little as 5 gm. p-dichlorbenzene or 5 ml. o-dichlorbenzene preventing hatching. Fuel oil alone or containing various amounts of p-dichlorbenzene did not give good results, and 5 per cent. DDT in fuel oil also was a poor larvicide. The addition of DDT to any solvent, however, left a toxic residue effective against emerging adults, and even though larvae were not killed, the production of adult flies was materially reduced.

Orthodichlorbenzene, acetylene tetrachloride, benzene hexachloride and Thanite (chiefly isobornyl thiocyanoacetate) showed promise when used to destroy blowfly larvae in dog carcasses. The first two, sprayed at 1 U.S. pint per carcass weighing 25–40 lb. killed the larvae almost instantly. They were highly effective when diluted 1 : 4 with fuel oil. An emulsion concentrate consisting of 20 per cent. benzene hexachloride, 68 per cent. benzene and 12 per cent. Triton X-100 (polyethyleneglycol alkyl aryl ether) proved very effective in field tests. Dilutions of 1 : 4 and 1 : 9 with fresh water caused almost instant cessation of movement of larvae and high kills when used at 1 U.S. pint per animal. Highly effective control was obtained with dilutions of 1 : 39, but the larvae were not quickly immobilised. Other solvents proved less effective in immobilising the larvae rapidly. A mixture of 20 per cent. Thanite and fuel oil gave remarkably good kills of blowfly larvae, although its action was somewhat slow. It is highly desirable to add 5 per cent. DDT to all the larvicides, except perhaps benzene hexachloride, because of the effectiveness of the deposit against flies that visit the carcass.

In view of reports of successful control of larvae of *Chrysomyia megacephala*, F., on battlefields by liberal application of a 0·6 per cent. solution of sodium arsenite to infested bodies and their surroundings, tests of sodium arsenite were made against larvae of blowflies, primarily *Cochliomyia macellaria*, F., in carcasses. They confirmed its effectiveness at 2·5 per cent. or more in water, but weaker solutions were relatively ineffective.

Griffiths jr. (J. T.). **DDT used to control Flies in Manila.**—*J. econ. Ent.* **39** no. 6 pp. 750–755, 2 figs., 2 refs. Menasha, Wis., 1946.

The following is based on the author's summary and conclusions. The city of Manila was sprayed from aeroplanes with DDT in diesel oil at about 8 oz. DDT per acre four times between 13th April and 27th June 1945. Treatments reduced the population of adult flies (predominantly *Musca* sp.) almost to zero, but the intervals of 3–4 weeks between sprayings were too long to produce cumulative effects. DDT spray dispensed over a limited area from a ground power spray machine at intervals of about ten days in June and July effectively reduced fly populations ; and they increased more slowly following each successive treatment. On the basis of the observations, it is suggested that the application of DDT at intervals of about ten days would be a satisfactory way of maintaining low adult fly populations during treatment and for a period thereafter.

Eddy (G. W.) & Carson (N. B.). **Effects of DDT on the Body Louse.**—*J. econ. Ent.* **39** no. 6 pp. 759–762, 2 refs. Menasha, Wis., 1946.

During investigations on the effectiveness of DDT against *Pediculus humanus humanus*, L. (*P. h. corporis*, Deg.), observations were made on the speed of

knock-down and kill of lice and their ability to feed and to defaecate after exposure. Freshly-fed adult lice, placed on cloth dusted with 10 per cent. DDT in pyrophyllite, were all immobilised in six hours, but mortality was not complete until after 20 hours' exposure. Lice starved for 24 hours were less resistant, knock-down and mortality being complete after five and 13 hours, respectively. Almost half of a batch of adult lice exposed to cloth impregnated with 2 per cent. DDT for three hours fed at the end of this time, but complete knock-down followed exposure for six hours. Defaecation of adults and second-stage nymphs was stimulated during the first four hours of exposure on cloth impregnated with 2 per cent. DDT, but thereafter the rate of defaecation dropped sharply and none was recorded after ten hours, whereas the defaecation of control lice remained about the same. Lice exposed for purposes of comparison to MYL powder, which contains pyrethrum as the primary toxic ingredient [*cf. R.A.E.*, B **34** 45], were completely immobilised when exposed for 15 minutes, and hungry lice were unable to feed after ten minutes. Exposure of freshly-fed lice for six and ten hours killed about half and all of them, respectively.

Eddy (G. W.) & Carson (N. B.). **Further Tests of the more promising Materials against the Body Louse.**—*J. econ. Ent.* **39** no. 6 pp. 763–767, 7 refs. Menasha, Wis., 1946.

The paralytic effect on *Pediculus humanus humanus*, L. (*P. h. corporis*, Deg.) of about 7,500 synthetic organic compounds and a few substances of plant origin, usually prepared as 1 per cent. solutions in acetone or some other solvent or occasionally as suspensions, was investigated in Florida from April 1942 to the end of October 1945. Circular woollen cloth pads were dipped in the solutions or suspensions, allowed to dry for 1–2 hours, and then placed in 50-ml. beakers together with 10 young adult lice and kept at 86°F. and a relative humidity of about 70–85 per cent. Lists are given of the compounds that paralysed the lice in 15, 30 and 60 minutes, of which there were 30, 28 and 119, respectively. The lasting and ovicidal properties and certain other characteristics of some of the better materials and factors influencing the results are discussed.

Linduska (J. P.), Cochran (J. H.) & Morton (F. A.). **Flea Repellents for Use on Clothing.**—*J. econ. Ent.* **39** no. 6 pp. 767–769, 3 refs. Menasha, Wis., 1946.

The results are given of preliminary tests of the repellency to fleas of 112 compounds or mixtures used to impregnate cloth and of practical tests of some of them. A tub containing several thousand adults of *Ctenocephalides canis*, Curt., and *C. felis*, Bch., was used. For the preliminary tests, cotton-twill strips that had been impregnated with acetone solutions of the repellents at 8 gm. repellent per sq. ft. and dried were exposed to the fleas for a few seconds and then raised above the tub out of jumping range of the fleas, and the number remaining on the strips after 30 seconds was compared with that remaining on untreated strips. Six, 20 and 26 of the compounds or mixtures repelled 100, 91–98 and 76–90 per cent. of the fleas, respectively ; 6-2-2, the mixture of dimethyl phthalate, Indalone (n-butyl mesityl oxide oxalate) and Rutgers 612 (2-ethyl-1,3-hexanediol) used as an insect repellent by the American forces [*cf. R.A.E.*, B **34** 10, etc.], repelled only 65 per cent. Several materials were also used to impregnate clothing and were found in this way to have the same order of repellency as they had in the preliminary tests. In practical tests in which socks and trouser legs were treated and the wearers stood in the tub, p-iso-prophylphenylethyl alcohol, 1,2,3,4-tetrahydro-2-naphthol and 2-phenylcyclohexanol prevented any fleas from crawling above the socks,

benzyl benzoate allowed only a few to do so and prevented bites. Indalone was less effective, 6-2-2 and dimethyl phthalate still less so, and Rutgers 612 afforded no protection, but the possible toxic or irritating properties of the first two compounds have not been ascertained.

BRETT (C. H.). **Repellent Properties of Extract of *Amorpha fruticosa*.**—*J. econ. Ent.* **39** no. 6 p. 810, 2 refs. Menasha, Wis., 1946.

In further investigations [*cf. R.A.E.*, B **36** 6], an acetone extract of the flowers of *Amorpha fruticosa* showed very little repellent effect against mosquitos (*Aëdes aegypti*, L., and *A. albopictus*, Skuse) though it was repellent to some other insects [A **36** 154].

FLUNO (H. J.), JONES (H. A.) & SNYDER (F. M.). **Emulsifiers for Liquid Acaricides.**—*J. econ. Ent.* **39** no. 6 pp. 810-811, 2 refs. Menasha, Wis., 1946.

As emulsions seemed to be the most practical form in which to use liquid acaricides for impregnating clothing against Trombiculids that transmit tsutsugamushi disease [*cf. R.A.E.*, B **34** 169 : **35** 190, etc.], various emulsifiers were tested by adding 10 per cent. to the liquid acaricides, forming an aqueous emulsion and observing it over a period. An emulsion was considered satisfactory if no separation of the oil phase occurred within two hours, but no separation within 24 hours was preferable. The results obtained with ten emulsifiers in distilled, hard or sea water are shown in a table. For use in all types of water with benzyl benzoate, dimethyl phthalate and dibutyl phthalate, all of which were used as acaricides in the Pacific war area, polymerised glycol monolaurate, polymerised glycol monooleate, and Tween 80 (a polyoxyalkylene derivative of sorbitan monooleate [*cf.* **35** 188]) appeared to be the best emulsifiers tested. A mixture of equal parts of Span 60 (sorbitan monostearate) and Tween 60 (a polyoxyalkylene derivative of sorbitan monostearate) also gave good emulsions, but was not completely soluble in these acaricides. For benzyl benzoate only, the most promising of the acaricides, Stearate 61-C-2280 (a polyalkylene glycol stearate), Tween 60, a mixture of equal parts of Span 20 (sorbitan monolaurate) and Tween 20 (a polyoxyalkylene derivative of sorbitan monolaurate) and one of equal parts of Span 80 (sorbitan monooleate) and Tween 80 also gave satisfactory emulsions in all types of water. Benzyl benzoate was more readily emulsified than dimethyl phthalate. Tween 80 and Stearate 61-C-2280 gave satisfactory emulsions with a mixture of equal parts of benzyl benzoate and dibutyl phthalate, which has been found better for impregnating clothing than the former alone. Some of the emulsifiers formed good emulsions with materials that are mosquito repellents, such as 2-phenylcyclohexanol and a mixture of dimethyl phthalate, Rutgers 612 (2-ethyl-1,3-hexanediol) and Indalone (n-butyl mesityl oxide oxalate) and the ingredients of this mixture separately. Although none of the emulsifiers interfered with the acaricidal properties of the toxic substances when used under experimental conditions in Florida, it will be necessary to test them under field conditions and to determine their possible irritation and toxicity to man before they can be used on a large scale.

WELLS (R. W.) & BARRETT jr. (W. L.). **Benzene Hexachloride as an Ovicide for the Short-nosed Ox Louse.**—*J. econ. Ent.* **39** no. 6 p. 816. Menasha, Wis., 1946.

The results are given of tests, mainly carried out in March and April 1946, on the toxicity to eggs of *Haematopinus eurysternus*, Nitzsch., of water suspensions of a wettable benzene-hexachloride powder stated to contain 7·5 per cent.

γ isomer. Lots of 100 eggs taken from cattle and each attached to a short section of hair were gently agitated for one minute in suspensions containing 1 or 0·1 per cent. γ isomer, dried for a few minutes on filter paper at room temperature and kept in ventilated paper pill boxes at 30°C. [86°F.] and relative humidities of 38·9, 75, 87·9 and 94·9 per cent. The percentages of untreated eggs that hatched at these humidities were 94, 84, 78 and 20, respectively. None of the treated eggs hatched. When two cattle were sprayed to saturation with a suspension containing 0·1 per cent. γ isomer, there was no hatch among eggs removed one hour later and kept at 30°C. and 75 per cent. relative humidity, as compared with 76 and 63 per cent. hatch among eggs removed before spraying. A heavy infestation on a cow was eradicated by spraying once to saturation with a 0·1 per cent. suspension. Concentrations of γ isomer varying from 0·05 to 0·01 per cent. gave complete kill of small numbers of eggs in other *in vitro* tests.

Ayroza Galvão (A. L.) & Damasceno (R. G.). **Observações sobre Anofelinos do complexo *albitarsis* (Diptera Culicidae).** [Observations on Anophelines of the *albitarsis* Complex.]—*An. Fac. Med. Univ. S. Paulo* **20** pp. 73–87, 1 pl., 21 refs. São Paulo, 1944. (With a Summary in English.)

In this paper, which was first presented in 1942, the authors review the nomenclature of *Anopheles albitarsis*, Arrib., and discuss the discrepancies in its morphology and behaviour that have been recorded in different parts of South America and in Panama [*R.A.E.*, B **26** 217]. On the Isle of Marajó, in the State of Pará, Brazil, at sea level, they found adults of this Anopheline that differed from those of São Paulo city, which is at an altitude of about 2,440 feet, in that they were smaller and had less of the hind tarsal segment black [*cf.* **36** 5]. The eggs showed a transitory mosaic pattern when first laid on damp filter paper. The females were extremely domestic in habit, the isolated dwellings being heavily invaded, particularly during the evening, in spite of the proximity of cattle, and an outbreak of malaria had taken place on one farm when an infected person visited it; the disease was quickly controlled by treatment, as the community was small and isolated, and did not recur.

Since the typical *A. albitarsis* from Buenos Aires is not domestic or anthropophilous, the authors consider that the form from Marajó represents a new subspecies for which they propose the name *domesticus*, n. [*cf.* also **36** 5], and that the mosquitos recorded as vectors of malaria in the coastal plain of Rio de Janeiro by Root [**14** 198], by Boyd, who originally referred to them as *A. argyritarsis*, R.-D. [**15** 23] and by Coutinho (1942), and in Campos, Rio de Janeiro, by Godoy & Pinto, under the name *A. braziliensis*, Chagas [**11** 201], which is another variety of *A. albitarsis*, are identical with it. They give characters distinguishing the adults of the new subspecies from those of var. *braziliensis* and the eggs from those of *A. albitarsis* from São Paulo. Galvão & Lane proposed the varietal name *limai* for the latter [**26** 184], since its eggs differed from those described by Root in the paper already cited [**14** 198]. The latter were considered by Root to belong to the domestic form of the coastal plain, which Galvão & Lane thought was the typical form, but they have characters never since observed in eggs of any form of the species. The authors therefore consider that they were misidentified and that var. *limai* is possibly identical with the typical *albitarsis*, eggs of the latter from Argentina being unknown. The terminalia of the males of var. *domesticus* from Marajó and also of those from the coastal plain, where the habits of the species are the same, are very similar to those of the non-domestic form from São Paulo, the Paraíba Valley and Tucumán, Argentina.

Schiavi (A.). **Nota sôbre mosquitos vetores em Iguape.** [A Note on the Malaria Mosquitos of Iguape.]—*Arq. Hig. Saúde públ.* **10** no. 25 pp. 69–75, 1 map. São Paulo, 1945. (With a Summary in English.)

An account is given of an Anopheline survey carried out in the early months of 1944 in Iguape, a coastal town in the south of the State of São Paulo, Brazil. The incidence of malaria, which was high at that time, particularly in January, and the prevailing climatic conditions are discussed and the geographical situation of the town is described and shown on a map. The main vector was found to be *Anopheles albitarsis*, Arrib., and in view of its striking domesticity and preference for man, it was thought to belong to var. *domesticus*, Galvão & Damasceno [see preceding abstract], although there were some divergences in the tarsal markings. Of 60 females taken in January in houses in which recent cases of malaria had occurred, five contained oöcysts on the stomach and two of these had sporozoites in the salivary glands. *A. albitarsis* was the only species found in houses, but small numbers of *A. intermedius*, Chagas, *A. oswaldoi*, Peryassú, *A. mediopunctatus*, Theo., *A. cruzi*, D. & K., and *A. bellator*, D. & K., were taken outside. Only one small breeding place of *A. albitarsis* was found near the city, and as there were no males among the adults and the latter were present only in waterfront areas and were most numerous when a sea breeze was blowing, it was concluded that they flew over from Comprida Island, a stretch of marshy territory less than a mile offshore. Both males and females were taken in shacks on the island, and mosquitos were observed in flight over the channel. Numerous oöcysts were found in one of the females from the island. Only one breeding place was discovered, on the Atlantic shore at some distance from any habitation, but the nature of the ground did not permit thorough search.

Lewis (D. J.) & Kirk (R.). **Five new Species of** *Phlebotomus* **(Diptera, Psychodidae) from the Sudan.**—*Proc. R. ent. Soc. Lond.* (B) **15** pt. 5–6 pp. 55–60, 5 figs., 1 ref. London, 1946. **The Male of** *Phlebotomus serratus* **Parrot & Malbrant (Psychodidae, Diptera).**—*T. c.* pp. 61–62, 1 fig., 3 refs.

Of the five new species described in the first paper, one belongs to the subgenus *Phlebotomus* and the others to the subgenus *Prophlebotomus*.

In the second paper, the finding of both sexes of *Phlebotomus* (*Prophlebotomus*) *serratus*, Parr. & Malb., in the Sudan is recorded, and the male is described. The species was originally described in a paper already noticed [*R.A.E.*, B **35** 48] from a single female taken in the French Congo.

Sandosham (A. A.). **Malaria in Malai. A Handbook for Anti-malaria Students.** —$9\frac{3}{4}\times6\frac{1}{4}$ ins., xv+288 pp., 11 pls. (5 col.), text ill., 20 refs. Syonan [Singapore], Syonan Tokubetu-Si, 1944. Reprinted, with corrections, 1945.

This handbook is compiled from the literature and is intended for the use of students of malaria control in Malaya. It contains information on the history and distribution of malaria and its importance in Malaya, microscopic, haematological and entomological technique, the life-history of the malaria *Plasmodium*, the classification, morphology and identification of *P. falciparum*, *P. vivax*, *P. malariae* and *P. ovale*, the type of malaria each causes, clinical considerations, immunity, the relation of climate and topography to malaria and endemicity and epidemicity in Malaya.

The section on *Anopheles* comprises data on the morphology of the various stages, classification, geographical distribution, life-history and habits, a list of the species and subspecies that have been recorded in Malaya, a review of the

results of experiments carried out there on infection of various species with malaria parasites and of dissections for natural infection, epidemiological evidence of the importance of the 11 species found naturally infected, geographical and seasonal distribution of the vectors in Malaya and the relation of agricultural practices to them, a summary of the available information on the morphology, prevalence, bionomics and importance in relation to malaria of the 17 species that are common or important in Malaya and the control of the important ones, and brief notes on the remaining 19 species that occur there, which are rare or of limited distribution and of no importance. There are illustrated keys for the identification of the larvae, and adults of both sexes of the 17 common species. These include *Anopheles letifer*, sp. n., the characters of the adult and larva of which are very briefly described and which has previously been identified as *A. umbrosus*, Theo., a species that is very rare in Malaya and is not known to carry malaria. *A. letifer* bites in the shade in the daytime and is considered one of the most important vectors in the plains and low hills, 17,339 recent dissections having yielded 1·15 per cent. positive results. However, its importance may have been overestimated owing to its confusion with *A. novumbrosus*, Strickl., which breeds within the jungle under heavy shade and among 3,594 females of which 0·86 per cent. infection was found. Some of these infections may have been with parasites of monkey malaria. When swampy jungle is felled, *A. letifer* commonly replaces *A. novumbrosus*.

Information is also given on the making of malaria and Anopheline surveys, and on the principles of malaria control, the application of oil and Paris-green dust and the use of drainage and naturalistic measures against the larvae and of protective clothing and netting, house screening and repellents against the adults. A brief section is appended on mosquitos other than Anophelines and their relation to dengue and filariasis. *Aëdes aegypti*, L., and *A. albopictus*, Skuse, the vectors of the former, are common throughout Malaya. The latter is caused by *Filaria* (*Wuchereria*) *malayi* and *F.* (*W.*) *bancrofti*, which are carried by species of *Mansonia* and by *Culex fatigans*, Wied., respectively. *F. malayi* is much the more common, and most cases caused by *F. brancrofti* are introduced.

Papers noticed by Title only.

Neal (P. A.) & others. **Results of Examinations of three Men having relatively long continued occupational Exposure to DDT.**—[2+] 44 pp., multigraph. Bethesda, Md., U.S. Publ. Hlth. Serv., Nat. Inst. Hlth., Industr. Hyg. Res. Lab., 1944. [See *R.A.E.*, A **36** 161.]

Neal (P. A.) & von Oettingen (W. F.). **The Toxicity and potential Dangers of DDT to Humans and warm-blooded Animals.**—*Med. Ann. District Columbia* **15** no. 1 pp. 15-19, 9 refs. [Washington, D.C.] 1946. [See *R.A.E.*, A **36** 161.]

Minutes of Conference on Toxicity of DDT to Man and other Mammals and the Hazards involved in the agricultural Use of DDT.—29 pp., multigraph. Washington, D.C., Nat. Res. Coun. Biol. Subcomm., 1946. [See *R.A.E.*, A **36** 162.]

Quintana y Marí (A.) & Cid Capella (A. M.). **Una nueva reacción colorimétrica del *p,p'*-DDT.** [A new Colour Reaction specific for p,p' DDT.]—*Bol. Inst. nac. Invest. agron.* no. 15 pp. 229–251, 18 refs. Madrid 1946. (With Summaries in English, French and German.)

SWELLENGREBEL (N. H.) & KRAAN (H.). **10 jaar spuitcampagnes tegen malaria.** [Ten Years' Spraying Campaign against Malaria.]—*Ned. Tijdschr. Geneesk.* **90** no. 41 pp. 1377–1380, 2 graphs. Amsterdam, 1946. (With Summaries in French, German and English.)

The spraying campaign in North Holland against Anophelines in houses that was begun in 1936 in Uitgeest and Marken [*cf. R.A.E.*, B **27** 51] was extended to include the villages of Wervershoof and de Streek in 1938 and the town of Alkmaar in 1941. Spraying with pyrethrum extract in refined petroleum oil was carried out at fortnightly intervals during the transmission period of malaria (August to November) [*cf.* **24** 283–285] in houses inhabited by persons who had suffered from malaria in the preceding few years, and figures are given showing that the numbers of cases of malaria in the villages in which spraying was begun in 1936 and 1938 declined sharply thereafter and remained consistently lower than in neighbouring unsprayed villages ; this was particularly noticeable in 1944–46, when most of the rest of North Holland was affected by an epidemic of malaria. In Alkmaar, however, the campaign appeared to have no effect on the number of cases, probably owing to insufficient preparatory work, since the expense of investigating the malaria history of a whole town is great.

SHANAHAN (G. J.). **D.D.T. as an Anti-ked Dipping Agent.**—*Agric. Gaz. N.S.W.* **58** pt. 7 pp. 389, 392, 1 fig., 2 refs. Sydney, 1947.

Experiments in New South Wales have shown that dips containing low concentrations of DDT are toxic to sheep keds (*Melophagus ovinus*, L.) whether the sheep are immersed in the dipping bath or treated by a power spray unit for which the dipping bath is the reservoir and sump. The wool of sheep sprayed with a dip containing 0·05 per cent. active DDT has been shown to remain toxic to adult keds for at least four weeks [*cf. R.A.E.*, B **35** 195], a period that should prevent survival of any keds, as most pupae give rise to adults within 28 days of deposition [**30** 32]. However, chemical analysis showed that there was a decrease in the DDT content of the liquid in the bath during treatment, and fresh experiments were arranged to obtain further information on the rate of loss. Analysis of samples taken in the course of them indicated that when sheep are treated within 6–7 weeks of shearing with dip fluids containing 0·1 per cent. active DDT, the concentration falls to 0·05 per cent. after about 500 sheep have been dipped or sprayed. Whenever this number has been treated, sufficient DDT should be added to restore the content to 0·1 per cent. This will ensure the concentration remaining above 0·05 per cent. at all stages of treatment.

In an experiment in which 100 rams each infested by about 30 adult keds and 50 pupae and having wool 1–1½ ins. long under the neck and brisket were sprayed with 0·1 per cent. active DDT, no living keds or viable pupae were found seven weeks later, although the wool of the neck region was incompletely wetted, presumably because the keds that emerged after treatment were killed on migration to a toxic area of wool.

MCDONALD (J.). **Annual Report of the Department of Agriculture (Cyprus) for the Year 1945.**—8 pp. Nicosia, 1946.

Of the 33 cases of infestation of cattle by *Hypoderma* reported in Cyprus during the winter of 1944–45, 32 were in districts (Paphos or the Tilliria) where cattle often graze with goats, but one larva was received from Famagusta. All the 20 larvae from the first two districts that it was possible to identify were *Hypoderma aeratum*, Aust., a pest of goats that occasionally attacks cattle, but the one from Famagusta was *Hypoderma bovis*, Deg., which was believed to

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have been eradicated [*cf. R.A.E.*, B **34** 209]. Reinfestation may possibly have resulted from the escape of larvae from cattle imported in December 1943 for slaughter in quarantine, but no other warbles in cattle were seen in the district in spite of careful search. During November and December 1945, only four cases of infestation were found in Cyprus, all in the Paphos district. Three of the larvae were *H. aeratum* and the fourth was unidentifiable.

PEFFLY (R. L.), DAVIDSON (R. H.) & WATERS (H. A.). **Studies in Laboratory Rearing of *Anopheles quadrimaculatus* Say.**—*Ohio J. Sci.* **46** no. 2 pp. 65–70, 2 figs., 2 refs. Columbus, Ohio, 1946.

In view of difficulties encountered in Ohio in rearing large numbers of *Anopheles quadrimaculatus*, Say, by Crowell's method [*R.A.E.*, B **28** 218], several modifications, an account of which is given, were devised and adopted. The rearing room measured $11 \times 6\frac{1}{2}$ ft. and was 10 ft. high. It was lighted during the day by a fluorescent lamp containing two 40-watt white tubes. The temperature was about 80°F. and the relative humidity 40–70 per cent. Adults for egg-laying were kept in a 16-mesh screened 30-inch cubical sleeve cage. A solution of 5 per cent. honey was supplied daily on cotton-wool and a rabbit with clipped belly, held on a rack that afforded no hiding places for the mosquitos, was introduced into the cage for $\frac{1}{2}$ hour. The sleeve was pinned round the neck of the rabbit, as it remained quieter if its head was not exposed to bites. Jars containing pupae were placed in the stock cage covered with a gauze cone with an opening at the top to allow adults to escape but prevent oviposition in the jars. On alternate days, a cage was placed over a jar from which adults were emerging and those obtained were dated for use in laboratory tests.

A pan of water for oviposition was put in the stock cage each day and removed the following day. The water was siphoned off and the eggs washed into a beaker. The contents of the beaker were then poured into a funnel sieve, in which the eggs were caught on double organdie. The organdie was then placed inside a waxed cardboard ring floating on water in a pan; it sank and left the eggs on the surface. The ring prevented the eggs from floating to the edge of the pan and adhering to the side following evaporation of the water. The larvae hatched two days later, and 250 were then counted into each of two dishes, 12 ins. long, 8 ins. wide and 2 ins. high, containing 150 ml. water. They were quickly and accurately counted by using a medicine dropper and a hand tally. The water was $\frac{1}{8}$ in. deep, and more rapid development was obtained than in water $\frac{1}{2}$ in. deep, possibly because, in the shallow water, the larvae swept the bottom with their mouth brushes and obtained the food that settled. Adding extra food to dishes of water resulted in the formation of scum, and made the water murky with gelatinous, flaky suspended material and a high population of bacteria and air-borne protozoa. This caused most of the larvae to die. The larvae were fed twice daily with a mixture of finely ground dog food and powdered dried brewer's yeast applied with a salt shaker. Pupation reached its peak most quickly when equal parts by weight were used. The amount of food per 250 larvae that gave slow or normal growth with low mortality and clear water and normal growth with high mortality and murky water are shown in a table for each instar. As the food fell on clear water the small particles scattered rapidly over the surface. This surface tension reaction did not take place where the water was clouded. Before the superiority of shallow water was discovered, it was found that the food would float on the surface for several hours if it was made into a paste, dried and flaked. This procedure reduced mortality from 29 to 2·7 per cent. in deep water and from 8·6 to 0·4 per cent. in shallow water; it is not recommended for shallow water in view of the extra work it involves.

The pupae were removed daily by means of a wide-mouthed medicine dropper and placed in 4–6 ins. fresh tap water in jars 6 ins. in diameter. Jars

this size accommodate 600–800 pupae. This technique produced a daily average of 490 pupae for seven and a half months with 94·8 per cent. emergence and peak pupation in 10–13 days after hatching.

DEVIGNAT (R.). **Aspects de l'épidémiologie de la peste.**—*Bol. Ofic. sanit. panamer.* **24** no. 10 pp. 895–906, 1 fig., 1 graph. Washington, D.C., 1945. (With a Summary in English.)

In connection with epidemiological surveys of plague at Lake Albert, Belgian Congo, between 1939 and 1943, and in view of the often confusing and contradictory nature of the findings of such investigations, the author has devised a plan of operations and a formula for summarising the results, with the object of standardising the procedure. Apart from pneumonic plague, which does not require an insect vector, plague is transmitted on three fundamental levels, occurring among wild rodents, among domestic rodents and in man. If transmission at these three levels and transmission between any two of them are considered separately, there are six possible lines of transmission, though transmission between levels is more or less accidental, as none of the insect vectors is truly common to any two levels. One or other level of spread may be lacking in a given region, and one or other line of transmission may be lacking or deficient ; it is this variation in transmission that gives rise to the diversity in the epidemiology of the disease.

It is suggested that for each line of transmission an index of transmissibility (Q) should be calculated, the formula for which is

$$Q=K\ [k(i+t)+k'(i'+t')+k''(i''+t'')\ .\ .\ .].$$

K is the proportion of mammals found naturally infected that are susceptible to a standard virulent dose, obtained if several numerically important species are involved by adding together the products of the susceptibility and frequency (relative abundance) of each of them and dividing this sum by the sum of the frequencies. The values for k, k′, k″ . . . represent the ability of the separate flea species to transmit, as indicated by the mortality of mice exposed to fleas infected in the laboratory by a standard procedure, which is described ; i, i′, i″ . . . are the numbers of fleas of each species taken on 100 trapped rodents or on 100 men in 24 hours ; and t, t′, t″ . . . are the average numbers of each flea species taken in 10 rodents' nests. It is difficult to establish a figure corresponding to t for man, since the numbers of fleas found in the floor dust of huts bears no relation to the numbers that attack man. The constant K cannot be calculated for man, but is doubtless equal to unity, since the susceptibility of man to plague is presumably the same everywhere, and in the author's investigations, the value k equalled either 1 or 0, since either all the mice became infected or none did.

In calculating the index of transmissibility between one level and another, where transmission is not necessarily equal in both directions, the formula should be applied to each direction separately and the results combined. From a compilation of results, a mean annual index of transmissibility could be obtained ; it could then be compared with similar indices obtained in the same manner from other regions, or for other lines of transmission. The principal objection to the formula is that it takes no account, on any given level, of the density of population and the consequent frequency of contact.

In distinguishing between the domestic and sylvatic levels, the habitat rather than the species of rodent was considered, since *Mastomys coucha* var. *ugandae*, the only domestic rat in the region, was also found in the forest, and was infested with domestic or forest fleas accordingly.

A full account is given of the technique employed in obtaining the data involved, including the method of catching rats, of collecting fleas from rats or

rodent nests, of preparing marrow suspensions from rats for injection into guineapigs, and of preparing the standard virulent dose used for testing the susceptibility of the rodents and the ability of the fleas to transmit.

Antunes (W.) & Castro (A.). **Zona endêmica da febre amarela no Brasil.** [The endemic Area of Yellow Fever in Brazil.]—*Bol. Ofic. sanit. panamer.* **24** no. 11 pp. 972–979, 3 maps, 2 graphs. Washington, D.C., 1945. (With a Summary in English.)

By 1944, the work of the National Yellow Fever Service extended over the entire populated area of Brazil, and 44,000 localities were covered by the organisation for control of *Aëdes aegypti*, L. [*cf. R.A.E.*, B **32** 217, etc.]. On the basis of experience since 1940, it is concluded that yellow fever is endemic in two areas, one comprising most of the territory to the north of a line joining the city of Brasilia, in Amazonas, to Gurupí, in Pará, and thence along the Gurupí river to the Atlantic Ocean, and the other a small area on the Atlantic coast, comprising the districts of Ilhéus and Itabuna in the State of Bahía. An outbreak of jungle yellow fever was in progress in 1945 in an area comprising parts of the States of Goiaz, Minas Gerais, São Paulo and Matto Grosso in which *Aëdes aegypti*, L., no longer exists, but the authors consider that areas of jungle yellow fever, in which the disease is normally quiescent and occasionally epidemic should not be classed as endemic areas. A map is given showing the areas discussed, together with maps and graphs illustrating the extent of the work of the Yellow Fever Service.

Torres Muñoz (N.). **La situación de la fiebre amarilla en Bolivia.** [The Yellow Fever Situation in Bolivia.]—*Bol. Ofic. sanit. panamer.* **25** no. 6 pp. 512–515, 3 maps. Washington, D.C., 1946. (With a Summary in English.)

The localities in which outbreaks of yellow fever occurred in Bolivia in 1932–40 and 1941–45 are shown on a map; no fresh areas were involved during the latter period. The full area of endemicity is considered to include all territory east of the Andes below an altitude of about 3,280 feet and north of 20°S. lat. Since 1936, all outbreaks have been of the jungle type; *Aëdes aegypti*, L., was eradicated from Bolivia in 1942, and apart from sporadic reinfestations from neighbouring countries, it has not recurred. In 1941–45, out of 2,354 samples of liver examined, 47 proved positive. Maps are included showing the sites of viscerotomy posts and the areas in which vaccinations were carried out.

Jannone (G.), Ferro-Luzzi (G.) & Mara (L.). **Risultati de una spedizione tecnico-scientifica nella Dancalia settentrionale esterna. (Studio agrario, entomologico, malariologico e di fisiologia alimentare.)** [Results of a technical and scientific Expedition in the outer northern Danakhil Country. Studies in Agriculture, Entomology, Malaria and Nutrition.]—*Monogr. Boll. Soc. ital. Med.* (*Sez. Eritrea*) no. 2, [1+] 167 pp., 23 figs., 2 fldg. maps, 63 refs. [Asmara] Med. & Agric. Dep. Brit. milit. Adm., 1946. (With Summaries in English.)

This report of the work of a scientific expedition that spent a month in January–February 1946 in the Danakhil country in southern Eritrea, between Massawa and Assab, includes a paper (pp. 69–126) in which L. Mara describes investigations on mosquitos and malaria. In an introductory section, he states that the expedition was preceded by six others undertaken in 1942–45, of which the itineraries are recorded, and gives an account of the methods

employed in the investigations. It was found that the distribution of mosquitos is greatly limited by ecological conditions, the mainly desert character of the country as a whole being unfavourable to both larvae and adults. The malarious areas are consequently restricted to two small stretches, of which the northern one included the Buri Peninsula and the lower belt of the Abyssinian highland. Conditions in this area are influenced by the proximity of the neighbouring malarious areas of the eastern lowlands of Abyssinia and the Rift valley, and malaria in it is attributed principally to the presence of *Anopheles gambiae*, Giles. The second area was the inhabited district round the port of Assab, in which malaria is transmitted by *A. adenensis*, Christ. [*cf. R.A.E.*, B **33** 47].

A list is given of the places in which water was inspected for mosquito larvae, with notes on the species found, the characteristics of their breeding-places, and their geographical distribution, both local and general, habits, and, in some cases, morphology. They comprised eight species of *Anopheles*, four of *Aëdes*, including *A. aegypti* var. *queenslandensis*, Theo. [*cf.* **32** 46] and several of *Culex*. The Anophelines were, besides the two already mentioned, *Anopheles dancalicus*, Corradetti, *A. dthali*, Patt., *A. funestus*, Giles, *A. rivulorum*, Leeson, *A. rupicolus*, Lewis, and *A. turkhudi*, List.; of these, only *A. funestus*, which was found on the Samoti plain, was regarded as of any importance as a vector of malaria.

The results of medical examination of the inhabitants of various sectors are given in tables, and maps are included showing the malarious areas, the distribution of *Anopheles* and *Aëdes* spp. and the places visited by the expedition.

THOMSON (R. C. M.). **Studies on *Anopheles gambiae* and *A. melas* in and around Lagos.**—*Bull. ent. Res.* **38** pt. 4 pp. 527–558, 1 pl., 3 figs., 1 map, 25 refs. London, 1948.

Ribbands, on the basis of the salinity reactions of the larvae, the characters of the larval pecten and the banding of the maxillary palpi of the adult females, considered *Anopheles melas*, Theo., to be specifically distinct from *A. gambiae*, Giles [*R.A.E.*, B **33** 32, 33], and the author supported him on the basis of differences in the egg [**34** 5]. They worked in Sierra Leone, but Chwatt, working at Lagos in Nigeria, considered none of these characters reliable enough to justify specific status for *A. melas* [**34** 138; **35** 99]. Whereas in Freetown Estuary, Sierra Leone, about one-third of the females of *A. melas* had a fourth dark band on the palpi, examination of females from Lagos showed that only about 5 per cent. of *A. melas* had four-banded palpi, while the remaining 95 per cent. were indistinguishable from *A. gambiae* [*cf.* **33** 33; **35** 6]. However, differences in the egg were found to constitute a reliable character for distinguishing the two species in the Lagos area. Difficulty was experienced in identifying only four out of more than 1,200 egg batches from females caught in nature. The difference can immediately be detected in unhatched eggs on filter paper examined under a low-power binocular microscope. Identification of eggs was the basis of the work described in this paper on the seasonal incidence and seasonal infectivity in 1945 and 1946 of adults of the two species in houses in different localities in and around Lagos.

The data obtained on seasonal incidence are given for each locality studied and discussed in relation to rainfall. The two species were about equally abundant in the area as a whole, but practically no examples of *A. melas* were found in most of Lagos town on Lagos Island. *A. gambiae* was normally dominant during the season of heavy rains (May–July), sharp increases in its abundance before the onset of the true rainy season were correlated with heavy showers, and borrow pits and fresh-water swamps that retained water throughout the dry season sometimes maintained it as the dominant species. Where there

were villages to act as a barrier, *A. melas* showed little tendency to move inland from the coastal fringe. It was not found at Surelere, a little over a mile from the coastal swamp. Its abundance is mainly determined by tidal movements. Examination for malaria parasites of the glands of over 2,000 females taken in houses showed that the sporozoite rate was consistently higher in *A. gambiae* than in *A. melas*, the average for all stations examined being 10 and 3·5 per cent., respectively. Comparison of fluctuation in sporozoite rate with seasonal incidence in a typical locality showed a striking inverse ratio for *A. gambiae* and a more or less direct ratio for *A. melas*. The relation in *A. gambiae* is what would be expected if all the mosquitos were produced beside the village and spent their lives within this limited area, whereas the relation in *A. melas* would be explained if older females tended to remain in the same locality only when suitable breeding conditions were present.

Out of 566 adults taken in 16 day-time catches in six catching stations and identified by egg characters, the proportion of blood-fed to gravid [**36** 65] was 7·5 : 1 in *A. melas* and 1·5 : 1 in *A. gambiae*. An intensive search of outside resting places of various types [*cf.* **36** 65] indicated that *A. melas* uses these resting places to about ten times the extent of *A. gambiae*, but no direct relation was found between indoor and outdoor catches at short intervals, and blood-fed females were quite as numerous as gravid ones. No females were found on hedges [*cf.* **30** 87]. The proportions of blood-fed and gravid females indoors in a village where excellent outdoor resting places were available and in one where there was none were the same. About 90 per cent. of blood-feeding by *A. melas* took place after midnight, with the peak an hour or two before dawn, and the figures for *A. gambiae*, which were rather small, showed the same general trend. Observations made with an experimental hut fitted with a window trap, which is described, showed that 26 and 43 per cent. of the freshly fed females of *A. gambiae* and *A. melas* left the hut at dawn and 70 per cent. of the remaining fed females of *A. melas* left at dusk, less than 24 hours after they had fed. The partial exodus at dawn is of the greatest importance in relation to spraying [**36** 65]. Several other species of *Anopheles* behaved similarly. Experiments with huts containing two men or animal bait and window traps in position indicated that *A. melas* may feed indiscriminately on man, goat, pig and cow if the proportion of animals is high, but with three huts containing six men (two in each) and three others containing eight animals, 98 per cent. of the mosquitos fed on the men. The percentages of blood-fed females going at dawn from huts containing men, pigs, or a cow varied from 10 to 40, but 94 per cent. of females feeding on goats left at dawn. Females of *A. funestus*, Giles, reacted to goat in the same way. *A. coustani*, Lav., showed a marked preference for cow, but no females of *A. funestus* or *A. gambiae* were found in huts containing cow or pig.

Swarms of males of either *A. gambiae* or *A. melas* were seen in June 1945 at Makoko. Both *A. melas* and *A. gambiae* were induced to pair in captivity by using artificial light, and the eggs laid were true to type. Healthy hybrid adults were obtained by cross fertilisation between *A. melas* and *A. gambiae*; the form of the egg was determined by the female parent. The hybrid females appeared sexually normal, though attempts to cross them with pure *gambiae* males were unsuccessful; but most, if not all, of the males were sterile with under-developed testes. Hybrid larvae from both crossings were tolerant to changes of salinity that killed all larvae of *A. gambiae* [**33** 32–33].

In the lagoon area around Lagos, which bears very little resemblance to Freetown Estuary [**34** 5–6], *A. melas* bred under various conditions, and *Avicennia* mangrove was of only limited value in indicating major breeding grounds, but no breeding occurred among unbroken *Rhizophora*. The movement of the tides is irregular and unpredictable, and populations of *A. melas* are therefore erratic. They may be influenced to some extent by rainfall. The

comprehensive tidal swamp reclamation programme in progress [**35** 4] should eliminate all the breeding places of *A. melas*. The observations of Barber & Olinger on the breeding places used by *A. gambiae* in and around Lagos [**20** 65] were confirmed. The importance of disused wells, exposed fresh-water swamps, and rain-filled pools and puddles is discussed. The present freedom of the greater part of Lagos Island from breeding-places of *A. gambiae* is almost certainly due to the slow and inconspicuous but steady progress in street drainage and swamp filling over a period of years.

DRESDEN (D.) & KRIJGSMAN (B. J.). **Experiments on the physiological Action of Contact Insecticides.**—*Bull. ent. Res.* **38** pt. 4 pp. 575–578, 12 refs. London, 1948.

The investigations described in this paper are noticed in more detail elsewhere [*R.A.E.*, A **36** 174]. They indicate that the powerful action of DDT, the γ isomer of benzene hexachloride and rotenone as contact insecticides is due to their ability to penetrate the insect cuticle and not to their having a specific action on the internal tissues of insects, since their toxicities to vertebrates (mammals and a frog) and to insects is of the same order if they are injected but not if they are applied to the skin ; that the insecticidal action of γ benzene hexachloride is greater than that of DDT because it penetrates more readily ; that the α, β and δ isomers of benzene hexachloride have little insecticidal action because their toxicity within an insect is low ; and that it is unlikely that γ benzene hexachloride acts by competing with meta-inositol in cell metabolism in insects [B **33** 131], since its toxicity to cockroaches was not affected by the simultaneous injection of meta-inositol.

JONES (B. M.). **Preliminary Tests of DDT Emulsion Concentrates.**—*Bull. ent. Res.* **38** pt. 4 pp. 585–590, 2 graphs. London, 1948.

DDT emulsion concentrates are of two types : " soluble-oil " concentrates consisting of DDT and an emulsifier in a solvent and " mayonnaise-cream " concentrates, which are themselves concentrated emulsions in which the solution of DDT is dispersed in water with the aid of an emulsifying agent. In both, the solvent is one in which the DDT is highly soluble. Emulsion concentrates are less bulky to transport than kerosene solutions, and emulsions are less toxic to operators and less inflammable than the latter. As it was thought that DDT might be as effective in an emulsion as in a homogeneous oil base as long as the emulsion was stable, emulsions prepared from four concentrates were submitted to preliminary physical stability tests before they were tried on a field scale. The composition of each is given. One was a mayonnaise-cream concentrate and the others soluble-oil ones. The DDT contained 60·5 per cent. p,p'isomer.

An emulsion was considered satisfactory if, at a concentration of 1 per cent. DDT, no visible separation occurred within two hours and only moderate creaming with no separation of the oil phase within 24 hours. The emulsion prepared from the mayonnaise-type concentrate and one other, both with solvent naphtha as the main ingredient, fulfilled these conditions, but two with mixtures of toluene and turpentine as the solvents and a different emulsifier did not. Repetitions of the tests with 5 per cent. concentrations gave the same results. Practical tests in which a 5 per cent. DDT emulsion prepared from one of the unsatisfactory concentrates was used in a knapsack sprayer gave results consistent with the laboratory tests. Stability was slightly improved when the container was shaken every five minutes. Samples of the emitted spray taken after the emulsion had been allowed to stand for 30 minutes in the knapsack container ranged from a liquid that was more or less water to one

with a high percentage of the oil-phase solvent containing the DDT. Only the mayonnaise concentrate formed a homogeneous emulsion when dispersed in salt water. Tests of the toxicity to *Armigeres obturbans*, Wlk., and *Culex gelidus*, Theo., of the deposit from emulsions prepared from the two satisfactory concentrates showed that emulsions containing 5 per cent. DDT left a deposit that compared favourably in persistence with that of the deposit left by a 5 per cent. kerosene solution.

SYMES (C. B.), HADAWAY (A. B.), BARLOW (F.) & GALLEY (W.). **Field Experiments with DDT and Benzene Hexachloride against Tsetse** (*Glossina palpalis*).—*Bull. ent. Res.* **38** pt. 4 pp. 591–612, 1 pl., 3 figs., 4 maps. London, 1948.

Details are given of field tests in Uganda on the use of DDT and benzene hexachloride to spray vegetation for the control of *Glossina* ; four were made on small islands in Lake Victoria and the fifth on a small peninsula on the mainland. The test areas, with their flora and fauna, and the weather on days when tests were made are described. The species of *Glossina* present was *G. palpalis*, R.-D. The method adopted was to treat fly concentration points, representing a very small proportion of the vegetation in the area, by hand spraying, and to estimate the destiny of the fly by collections at catching stations throughout the area. Brief descriptions are given of the methods of determining deposits of DDT and benzene hexachloride and making laboratory tests of their toxicity to captive flies. There appeared to be an appreciable loss of both insecticides through penetration into leaves [*R.A.E.*, B **36** 19]. The solutions showed little scorching of glabrous leaves, but whole shoots of plants with soft hairy leaves died.

In the first three experiments, single applications of an oil solution of benzene hexachloride at 11 mg. γ isomer per sq. ft., or of DDT at 100 mg. DDT (83 per cent. p,p′) per sq. ft., reduced the numbers of *G. palpalis* by 50–80 per cent. for 1–2 weeks only. Semi-field and laboratory tests showed that deposits on vegetation lost toxicity in 1–2 weeks.

In the other two experiments, therefore, four applications were made in an attempt to maintain a toxic deposit over the maximum pupal period of about 55 days. Labour and costs are discussed. In one, DDT solution was applied on an island at intervals of 10–14 days. The first application was made on 6th and 7th May, and mean density catches fell from 2·2 flies per station on 4th May to 0·2 on 11th, but had risen to 0·7 a week later. A noticeable reduction followed each subsequent spraying, then density increased slightly from a few days after treatment until the next application. No flies were seen for several days after the fourth spraying, then one or two were caught each day. From the sixth to the 13th week after this application, no flies were seen or caught, but two were then taken.

In the fifth experiment, on the peninsula, two applications of an emulsified solution of DDT in solvent naphtha were followed by two of a solution of DDT in dieseline. They were made at intervals of 14, 18 and 6 days. There was no scorching of glabrous leaves, but the solution caused scorching of some soft leaves. The period of 48 days for which deposit was probably maintained was too short. Over the whole area, fly densities were reduced by about 98 per cent. by the four applications ; the duration of effect of the last one could not be definitely ascertained, because cattle brought flies into the experimental area from infested bush outside it. Insecticidal deposits were rather small, but deposits from the emulsion persisted for several weeks despite heavy storms. *Dracaena* leaves had surface deposits of 116 and 173 mg. per sq. ft. 8 and 16 weeks after its application and gave kills of 100 and 93 per cent., respectively, of flies exposed to 20 seconds' contact with them. Deposits on hairy leaves gave

negligible kills, possibly because the hairs prevent contact between the tarsi of the flies and the deposit. In the rainy season, the proportion of treated foliage is rapidly reduced by growth.

It is concluded that this laborious method of application, even with excessive dosages, is not likely to eliminate *G. palpalis*. As no very thorough study of the fly was made and only a relatively small proportion of the vegetation was sprayed, some important places such as female resting places were untreated. In very small fly belts, it would be possible after detailed study to treat most of the resting places and patrol routes of the fly and so probably eliminate it, but to do this in extensive belts would be impracticable. Attempts should be made to develop formulae that will not be absorbed and will not lose toxicity during prolonged exposure, and to devise a method of application that will give much greater coverage than can be achieved with small knapsack sprayers.

NORRIS (K. R.). **The Use of DDT for the Control of the Buffalo Fly** (*Siphona exigua* (**de Meijere**)).—*J. Coun. sci. industr. Res. Aust.* **20** no. 1 pp. 25–42, 11 refs. Melbourne, 1947.

An account is given of experiments carried out principally at Malanda, in northern Queensland, in 1944 and 1945 on the use of DDT against *Siphona* (*Lyperosia*) *exigua*, de Meij., on beef and dairy cattle. Persistence of the DDT on cattle may be measured by chemical analysis of extracts from large samples of hair clippings, by bio-assay tests of clipped hair, by insectary tests or by a study of the trend of populations on a treated herd. A procedure for using the bio-assay method is described. The rate of reinfestation of cattle is affected by the natural variation in fly population, the effect of weather on fly activity, and the size of the property on which the treated stock graze.

In spraying to control the fly, the hides of the cattle may be saturated to leave a deposit affording lasting protection or sprayed frequently with a light-mist spray of low persistency. The former and more widely applicable method was first tested with solutions of DDT, principally in kerosene. These experiments showed that saturating the neck, back and sides with a 4 per cent. solution considerably reduced infestation for two or three weeks; spraying these parts of only the most heavily infested half of the herd eliminated all flies from the sprayed animals immediately and nearly all from the untreated ones in 22 hours, keeping the infestation on the whole herd very low for three weeks; and spraying areas 18 by 12 ins. on each flank and each side of the withers kept the cattle practically free of flies for 12 days [*cf. R.A.E.*, B **33** 152; **35** 92]; but spraying the bull and every fourth cow was not so satisfactory as treating half the herd. However, if kerosene solutions are applied as saturating sprays, the oil is likely to injure the animals' skin. Tests were therefore made with emulsified solutions of DDT, using power kerosene, solvent naphtha (b.p. 90–190°C.) or *Eucalyptus dives* type oil [**35** 116] as the solvent and "Wetsit" as the emulsifying agent, and also with Rucide, a paste containing 50 per cent. by weight of p,p'DDT and a "solubiliser", which is melted until it forms a clear liquid at a temperature over 100°C. [212°F.] and then stirred into soft or softened water, when a stable suspension of fine particles of DDT results. Rucide and the emulsions were apparently harmless to the skin of cattle, and gave satisfactory results in several experiments in which the shoulders only of all cattle in a herd were sprayed. There was evidence that DDT persists longer on the shoulders than on the flanks, so that the result of spraying the entire body is much the same after a preliminary period as treating only the upper parts. There was no outstanding difference in persistence between different solutions and emulsions, but the persistence of emulsions tended to vary with concentration, though trebling the concentration did not even double the protective period. Persistence did not appear to increase with an increase in the concentration of Rucide between 0·5 and 3 per cent. w/v p,p' DDT [*cf.* **35** 91].

Solutions of DDT in power kerosene were quite suitable for application as light-mist sprays, which were best delivered by ordinary household atomisers. Experience in their use showed that all flies caught in the mist are killed, and the light deposit left on the places where the flies cluster, to which the spray is directed, kills flies alighting on the cows after spraying. The initial reduction of a gross infestation necessitates spraying most of the herd, but later it is generally enough to spray a few cows every day to keep the number of flies low (less than 12 per animal). A quart of 4 per cent. DDT solution will protect 30 cows for about a month.

In dipping experiments with long-haired cattle carried out at Rannes, in central Queensland, principally on the control of *Boophilus annulatus microplus*, Can. (*australis*, Fuller), the flies did not work back to the undipped animals when 1 per cent. Rucide was used as they do with an arsenical dip ; they did not tend to gather round the entrance to the vat, and very few followed the cattle to the draining pen. Most of those seen there were strongly affected by DDT, and the Rucide seemed slightly repellent while the hide was still wet, as flies that alighted remained for a moment only. Most were probably knocked down by a mist caused by the plunging of the cattle. Some hours after dipping, cattle were standing quietly in the shade, and no flies were seen. Previously heavily infested animals remained almost free of flies until they were retreated after an interval of five weeks, except for small numbers on a batch that had been grazing next to heavily infested untreated cows. Young, dipped heifers mixed with more than half their number of heavily infested, mature cows five days after treatment, carried no flies when drafted out the following day, and infestation on the cows was much reduced. Drafting on the tenth day after a similar exposure to reinfestation on the ninth day still revealed no flies on the heifers, but the reduction on the cows was smaller. A light infestation was seen on the treated heifers on the 15th day after reinfestation the day before, but very few flies could be seen 4–5 hours after drafting. In bio-assay experiments with *S. exigua* as the test insect, strong traces of DDT were found on hair taken from the shoulders of some animals on the fifth and seventh days after dipping. There were still fairly strong traces on hair taken from the shoulders on the tenth day, but much less on hair from the flanks. Samples taken on the 14th day showed some DDT on the shoulders of four of the ten cattle but only weak traces on the flanks of two of them. As the life-cycle of the fly was estimated not to exceed ten days at the time of the tests, the action of the deposit was probably lasting enough to kill all flies emerging from the dung on the property on which the treated cattle grazed. The initial population was thus eliminated and reinfestation depended on infiltration. As the area grazed was a compact block of about 15,000 acres, this is an adequate explanation of the long period over which the cattle remained free of flies [*cf.* **35** 93–94].

Spraying with a solvent-naphtha emulsion containing 1 per cent. crude DDT (75–80 per cent. p,p′ DDT) from a spray race with rows of nozzles above and below the cattle on each side was tried on cows infested with about 50 flies each. No flies were seen in the draining pen and there was no accumulation of drowned flies in the gauze screens of the filters over the reservoir. During spraying, about a dozen flies strongly affected by DDT were caught in a net standing down-wind from the entrance to the race. Marked cows remained entirely free from flies for nine days. After this, a few were seen, but reinfestation was not considerable during the five weeks following spraying. Small samples of short hair from the shoulders showed fairly strong evidence of DDT on the third and fifth days after spraying but only one sample was positive on the eighth day. Spraying steers with 1 per cent. Rucide prepared with rain water had the same effect on the fly population as dipping, whether the steers were kept with dipped animals or in a separate paddock, and results of examination of hair samples from the shoulders and flanks were comparable with those of

samples from the dipped cattle. The more rapid disappearance of DDT from the flanks than from the shoulders was confirmed.

The persistence of DDT on a living animal is much shorter than it is on a piece of hide [**35** 73]. It is affected by the rate of application, and an experiment is described providing evidence that the persistence of deposits from solutions (in solvent naphtha), like that of deposits from emulsions, is affected by concentration. Persistence appeared to diminish, however, when the concentration exceeded 12 per cent., probably because the more concentrated sprays caused scalding and desquamation. It was shown that rubbing and licking probably remove considerable quantities of the DDT [*cf.* **36** 105]. Dust or mud may be involved, but DDT disappeared from cattle grazing on unbroken swards. The effects of sun and rain appeared to be slight, and natural shedding of the hair was ordinarily insufficient to account for much loss but may be a factor during the post-winter moult. Absorption into the hair is probably not a factor; absorption into the skin is more likely, but more difficult to detect. Removal or destruction by skin secretions has not been investigated.

Where the use of arsenical dips is continued against ticks, the small dose of DDT required to control *S. exigua* may conveniently be applied in the draining pen (preferably from a raised platform), or just afterwards in a smaller pen. Cattle entering a dip with a wet deposit of DDT emulsion on the hide lost about 95 per cent. of the DDT. According to the scale of the operations, applications should be made with knapsack sprayers, motor-driven pumps or a simplified spray race with draining floor and a few permanently-fixed jets to treat the upper parts of the animals. Emulsions containing 4 per cent. DDT remained effective for nearly three weeks, the interval between dippings for tick control. Rucide at 1 per cent. (0·5 per cent. p,p′ DDT) kept the cattle practically free of flies for about a fortnight. Rucide is the most suitable preparation available for the control of *S. exigua* on a large scale, but emulsions are more convenient for small-scale use, as, owing to its stratification in solidified form, the whole of a lot of Rucide must be melted before a portion can be removed. Spraying over shoulders only with 1 per cent. Rucide is the cheapest method of control. About 3 gals. spray are needed for one treatment of 100 cattle, and about seven sprayings are required during the average fly season of five months. This method is so cheap and effective that the use of traps [**35** 117 etc.] is no longer considered economical. The cost is discussed.

HITCHCOCK (L. F.) & MACKERRAS (I. M.). **The Use of DDT in Dips to control Cattle Tick.**—*J. Coun. sci. industr. Res. Aust.* **20** no. 1 pp. 43–55, 3 refs. Melbourne, 1947. **Addendum (February, 1947).**—*T.c.* p. 55.

In view of the increasing difficulty experienced in parts of Queensland in controlling *Boophilus annulatus microplus*, Can., by means of arsenical dips, even with fortnightly dipping [*cf. R.A.E.*, B **35** 130], experiments were carried out in 1944 and 1945 with sprays of DDT and later with dips of Rucide [see preceding abstract]. The aim was to reduce the tick population to a level at which minimum damage would be done while allowing enough transmission of piroplasmosis [*Piroplasma argentinum* and *P. bigeminum*] for cattle to maintain their immunity.

Semi-engorged nymphs on artificially infested cattle were relatively resistant to 0·5 per cent. DDT in alcohol and all other parasitic stages highly susceptible [*cf.* **33** 152]. On naturally infested cattle sprayed with emulsified solutions, 0·5 per cent. DDT gave a good kill of ticks, 1 per cent. a very good kill and 2 per cent. practically consistently a complete kill. Larvae failed to attach

for 7, 9–10 and 10–12 days with the three concentrations, respectively [*cf.* **33** 152; **35** 72]. The 2 per cent. emulsion gave these results consistently in September, December, April and July. Sprays containing 0·25 and 0·5 per cent. DDT in the form of Rucide gave good and very good kills and 1 and 2 per cent. gave complete kills, and the four concentrations gave protection for 7, 10, 12 and 15 days, respectively, when tried on one animal each.

As dipping was expected to wet the cattle more efficiently than spraying, 1 per cent. Rucide (0·5 per cent. DDT) was used for the first two dipping experiments. No evidence of DDT poisoning was seen in 21 animals exposed in various ways to dosages much greater than could be absorbed from this treatment. Cattle rest and feed quietly after dipping in DDT, showing no signs of immediate irritation or later scalding. The preparation of a Rucide dip and of the initial concentrate for it [but *cf.* below, p. 105] are described. A moderate layer of silt on the bottom of the bath is beneficial, as it prevents caking of the DDT that settles and ensures that it will redisperse when stirred. If soft water is not available, a softener is required, and Calgon (sodium hexametaphosphate) at 1 oz. per degree of hardness per 100 gals. was successfully used. The dipping experiments were made in four areas of Queensland. Some of the ticks were arsenic-resistant and some were not.

When 1,800 cattle were dipped in 3,000 gals. suspension at Rannes on 8th and 9th February 1946, kill was slow, reaching a maximum in 5–6 days, but most animals were freed of ticks and none had more than ten survivors. The protective period was 6–10½ days. A fortnight later, the same dip, stirred but with no addition, gave similar results. Three months after it had first been used and two days after 1,000 gals. suspension had been added and 1,000 bullocks dipped, it killed all but six ticks on 60 animals and gave protection from re-infestation by larvae for 15 days. On 16th July, when 5,400 cattle had been dipped at Rannes (all between February and May) and 7,600 gals. suspension had been used, ticks were still extremely scarce. On 17th July, the dip gave complete control of ticks of all stages on 70 bullocks from a neighbouring property, where they had been treated with arsenic without success. The suspension was still active on 16th October.

At Toomba, where the ticks were arsenic-resistant, a dip of 2,400 gals. was charged on 29th May, and heavily infested cattle that had recently been dipped in arsenic were passed through it next day. Of 20 heifers kept back for close examination, nine showed surviving ticks seven days after dipping. The most found on a single heifer was ten, which had been nymphs when dipped. Reinfesting larvae were first detected 18 days after dipping. Kill on cows and calves appeared to be complete except on the heads of some of the cows, which may have been kept out of the dip. The protective period was 12 days. From 30th May to 14th September, 5,735 cattle were dipped and 2,540 gals. suspension added, and ticks remained scarce, while infestations were light to heavy on control paddocks. On 14th September, 560 gals. suspension was added to the dip and 200 bullocks were put through. They were free of infestation 18 days after, though they had been returned to an area where ticks had remained active and DDT had not been used.

At Gracemere, a dip of 1,600 gals. capacity was filled on 23rd July with hard water and charged with 168 lb. Rucide and 40 lb. Calgon. On 24th, 182 cattle carrying light to moderate infestations of ticks in all stages were dipped. Kill was almost complete. Re-infesting larvae were found after 11, 14 and 22 days, but there was none beyond medium size even at the last examination. Two bullocks that had not been dipped for several months and had heavy infestations and a thick matted winter coat were also dipped on 24th July; 50–100 nymphs and adults survived on each. One was re-dipped on 29th, and it was free of infestation on 15th August, while the other carried three adult ticks. By 5th September, there was only about 800 gals. in the bath, and 450 gals. water,

45 lb. Rucide and 11½ lb. Calgon were added. Dipping of 139 animals carrying a light to moderate infestation of ticks in all stages, after an interval of six weeks, freed the majority of ticks, leaving a few survivors on others.

At Innisfail, 156 beef and dairy cattle were dipped on 6th August in 1,860 gals. 0·9 per cent. Rucide. Isolated surviving ticks were found on about half the dairy cattle, the first re-infesting larvae were observed after 15 days and the first engorged adult resulting from re-infestation after 35 days. These animals were considered to need re-dipping on 17th September. The beef cattle were in three lots. Seven weeks after dipping, one lot was heavily, the second lightly, and the third very lightly infested. All were re-dipped with satisfactory control and a protective period of 7–9 days.

It is not certain whether large adult ticks were all killed or whether some dropped off naturally. Engorged adults collected after spraying had usually failed to lay viable eggs, but a few kept at high humidity did so. Engorging nymphs were always the last ticks to die. The difficulties of estimating percentage kill are discussed. Of 218 animals from the four sets of experiments with light to heavy infestations at the outset, kill within one week of dipping was complete on 153, nearly complete (less than ten ticks surviving and growing) on 61 and incomplete (20–100 ticks in various stages) on four. As a light infestation is seldom less than 1,000 ticks, the kill with 0·5 per cent. DDT was estimated from this to be complete on 70 per cent. of the animals carefully examined, less than 100 but more than 99 per cent. on 28 per cent. and more than 90 per cent. on the remaining 2 per cent. when allowance was made for the heavy infestations they carried. The mean protective periods varied from 8½ to more than 18 days.

With a protective period of ten days and a development period of 22 days, a dipping interval of about four weeks might seem necessary, but the rate of re-infestation was usually slower than might be expected and re-dipping after 6–7 weeks generally kept infestation light. This may have been because of retardation of re-infestation in some places by dry, cold weather, an excess of effective protection time over complete protection time, and a tendency for cattle carrying a poisonous deposit to act as poison baits and affect the general tick population. The intervals between subsequent dippings were generally longer than those between the first and second. The advantages of the DDT suspension, as compared with an arsenical dip, are efficiency in controlling ticks, whether arsenic-resistant or not, lengthening of the interval between dippings, probable extermination of the buffalo fly [*Siphona exigua*, de Meij.], possible control of other pests, absence of irritation or scalding, and a probable improvement in condition and productivity resulting from a combination of these four factors. The disadvantages are greater cost (about nine times as much for materials) and greater trouble in preparing the dip.

It is stated in the addendum that it has been found satisfactory to pour the molten Rucide slowly into the vat while the water is being stirred without first making a concentrate, and that analyses indicate that the DDT content of the dip often falls in use to 0·35 per cent. or less, so that it is recommended that not more than 500 gals. water should be added for each 56 lb. drum of Rucide. The dips have been studied at three other localities with essentially the same results as those recorded in the paper.

HACKMAN (R. H.). **The Persistence of DDT on Cattle.**—*J. Coun. sci. industr. Res. Aust.* **20** no. 1 pp. 56–65, 2 graphs, 13 refs. Melbourne, 1947.

Deposits of DDT from preparations containing up to 2 per cent. remain effective for only 1–2 weeks on living cattle. An account is given of observations showing that the most important factor causing the removal of the DDT from

sprayed cattle is licking, either by the animal concerned or by another [*cf. R.A.E.* B **36** 103]. Rubbing, solar radiation and rain are shown to play only a minor part, and growth and loss of hair, production of skin secretions, absorption into the skin and hair and flaking of the epithelium to be of even less consequence. The observation that raising the concentration of DDT from 1 to 2 per cent. increased persistence only slightly [*cf.* **36** 101] is readily explained when it is realised that the animals themselves remove the DDT. An oil spray stimulates secretion, and this in turn stimulates licking. It is possible that the stimulation of secretion could be prevented and persistence of the DDT consequently increased by using water suspensions instead of emulsions. It is considered that the amount of DDT ingested by licking is not sufficient to produce toxic symptoms.

Eyles (D. E.), Sabrosky (C. W.) & Russell (J. C.). **Long-range Dispersal of *Anopheles quadrimaculatus*.**—*Publ. Hlth Rep.* **60** no. 43 pp. 1265–1273, 2 pls., 1 fig., 7 refs. Washington, D.C., 1945.

For 25 years, the control of *Anopheles quadrimaculatus*, Say, has been based on the assumption that one mile is its maximum effective flight-range, and the soundness of this as a general principle is not questioned [*cf. R.A.E.*, B **32** 208]. However, females were apparently dispersing for remarkable distances from the Santee Reservoir in South Carolina in 1944, and in view of the importance of the flight-range of Anophelines, an attempt was made to confirm this. Pertinent data from the literature are recorded. The reservoir is 37 miles long and occupies 97,000 acres. Before impoundment in 1942, a zone was cleared along the edges, one mile wide round the lower part and half a mile wide around the upper part. As a result, the centre of the reservoir over most of its length consists of a flooded swamp, about 47,000 acres in extent, with a dense stand of dead trees and considerable floatage in water from a few inches to many feet deep. Breeding of *A. quadrimaculatus* was widespread in the upper part of this swamp, and was intense more than two miles from the nearest good source of blood. Adults were numerous even a mile from the 75-ft. contour (the normal maximum water level). Counts at the few stables within ¼ mile of the water showed as many as 5,300 females, and up to 275 were taken at index stations over a mile from the contour.

In the area selected for study, there was heavy breeding in the central swamp and practically none in the cleared half-mile marginal zone, which consisted of open water on the south-west side (Calhoun county) but largely of an island separated from the land by a slough on the north-east side (Clarendon county). There was no local breeding above the normal high-water level, and no blood-meals were available near the main breeding areas. Catching stations with large adult populations were easily accessible. Malaria has long been a problem in the area. About 3,500 marked females, nearly all freshly engorged or gravid, were released in the centre of the swamp on a shady island near some hollow trees, in which they took shelter. Attempts at recovery were made on the four days following release and on the sixth and eighth days, a total of 40,863 females being examined from 15 stations 2·05–3·95 miles from the place of release on both sides of the reservoir. Marked females were found in eight stations. The numbers taken on the six days were 1, 1, 15, 3, 1 and 0, respectively. One was taken 3·63 miles from the point of release, three 2·5–3 miles and the others 2·05–2·5 miles. In no case was there any intervening habitation with blood sources between the point of release and a station from which a marked mosquito was recovered, and all but one of the recovered mosquitos were freshly engorged. All of the recoveries were made on the Clarendon side, except that of the mosquito that had flown for 3·63 miles, but only one of the Calhoun

stations was within three miles of the release point, and about 12,000 of the 17,000 Calhoun females examined were from over 3·6 miles from the point of liberation.

It is concluded that in the area, females of *A. quadrimaculatus* in dangerous numbers are dispersing up to 2·7 miles. This is probably due to the very prolific breeding over vast areas and the absence of domestic sources of blood along the line of flight [*cf.* **32** 41]. The results indicate the desirability of ascertaining the flight-range in individual areas in which it is proposed to institute control measures before deciding the limit of operations.

KNOWLES (F. L.) & SMITH (C. S.). **DDT Residual House Spray—a Method of Malaria Control in rural Areas.**—*Publ. Hlth Rep.* **60** no. 43 pp. 1274–1279, 2 refs. Washington, D.C., 1945.

The practicability of spraying houses in the southern United States with DDT to leave a toxic residue for the control of *Anopheles quadrimaculatus*, Say, was studied in 1944 in an area 36 sq. miles in extent in a cotton-growing part of Arkansas. Of the 545 houses in the area, only 27 were adequately screened, and 232 had no screening. Most could not be properly screened because of their bad condition. Two operators treated 1,236,690 sq. ft. in 513 houses with 417 U.S. gals. spray in 86·4 hours with 99·8 hours travelling time between 4th July and 14th August. The spray was made from a concentrate (23 per cent. DDT, 71 per cent. xylene and 6 per cent. Triton X-100) diluted to concentrations of 5, 2·5 or 1 per cent. DDT, and was delivered in a fan shape from a power sprayer at 0·16 U.S. gal. per minute at a pressure of 100 lb. Nearly complete coverage was obtained. The calculated deposit of DDT for the spray containing 5 per cent. was 64 mg. per sq. ft. Cost is discussed. Inspections of walls and ceilings were made daily from 15th August in the first two hours after daybreak in selected sprayed houses and again later in the day in these houses and unsprayed ones. The floors of some houses were covered with flies after spraying, and moribund mosquitos were also found, though it is known that mosquitos usually attempt to leave a house when affected by DDT in it. The average numbers of resting females of *A. quadrimaculatus* found per house from 15th August to 14th September in houses receiving 1, 2·5 and 5 per cent. DDT were 4, 1·7 and 1·34 at the early inspections and 2·32, 0·92 and 0·17 in these houses and 6·2 in unsprayed houses at the later ones. The corresponding figures for the following month were 2·5, 2·6 and 1·86 at the early inspections, and 1·2, 0·93, 0·43 and 3·6 at the later ones.

MARIANI (M.). **Contributo alla conoscenza della tecnica di allevamento dei *Phlebotomus* ed alla conoscenza morfologica e biologica della specie *papatasii* Scop. (Diptera, Psychodidae).** [A Contribution to the Knowledge of the Technique of rearing *Phlebotomus* and of the Morphology and Biology of *P. papatasii*.]—*Riv. ital. Igiene* **4–5** nos. 7–12 repr. 16 pp., 8 figs., 1 graph, 1 ref. Pisa, 1945. (With a Summary in English.)

A description is given of a method of rearing *Phlebotomus* that has given good results in Palermo. Captured females are allowed to oviposit on blotting paper in individual test-tubes and are then preserved for identification. Each paper bearing the eggs is placed in a small porous dish made of kaolin, which is covered with a glass plate and set on a double disk of blotting paper in a glass dish. The kaolin dish is soaked in water for 25 30 minutes before use, and the blotting paper is kept saturated throughout the process of rearing.

The food provided was dried powdered ox heart, which was dusted over the bottom of the kaolin dish, but the larvae also fed on the moulds that developed on the blotting paper. It was found possible to rear *Phlebotomus* on the moulds alone, but they took ten days longer to complete their development. When adults were seen to be emerging, the dishes were removed to gauze cages and uncovered. The males were fed on sweetened water on blotting paper and the females were offered a blood-meal daily ; absorbent cotton soaked in water was also provided.

The only species found in Palermo in 1945 was *P. papatasii*, Scop., of which adults were present from the second half of April until the first half of December, though the great majority emerged in June–September, the curve of emergence of *P. papatasii* corresponding closely to that of the incidence of sandfly fever. Oviposition occurred within a week in spring and summer. A table is given showing the duration of development of several generations in the laboratory, some of which were subjected to coloured lights. Eggs laid in June and July at mean monthly minimum and maximum temperatures of 25–26 and 29–30°C. [77–78·8 and 84·2–86°F.] hatched in 6–8 days, but there were considerable variations in the duration of the later stages ; total development was completed in some 4–6 weeks in summer. Red light delayed larval development and green light accelerated it. The adults were considered to reach sexual maturity 6–7 days after emergence, when pairing and the first blood-meal took place. The females fed at any hour of the day ; they fed readily on man, but fed on a guinea-pig only in cases of extreme hunger, and if it was carefully shaved. The reactions to the bites (duration of the irritation and effect on the skin) varied considerably from one person to another.

As adults of both sexes fed readily on sweetened liquids, bunches of dry leaves dipped in syrup poisoned with sodium or potassium arsenite were hung near the ceilings of infested rooms, and the numbers of sandflies taken in these rooms were found to be only 3–5 per cent. of those usually taken. The abundance of *Phlebotomus* was found to be in no way connected with bomb damage, since the sandflies were most numerous in quarters that had not suffered in air raids. In one ground-floor bedroom, an average of 150 was taken in each weekly visit between early July and the end of August. Their abundance was attributed to drought and to inadequate cleaning of the street gutters, where decaying matter offered excellent breeding conditions. The author considers that heavy rains, or washing down with hoses, would have destroyed a great number of larvae.

The egg of *P. papatasii* is described and notes are given on some features of the morphology of the larva and pupa ; the larvae were found to possess ocelli, which had not previously been recognised, and were negatively phototropic.

Papers noticed by Title only.

da Costa Lima (A.) & Hathaway (C. R.). **Pulgas. Bibliografía, catálogo e hospedadores.** [Fleas. Bibliography, Catalogue and Hosts.]—*Monogr. Inst. Osw. Cruz* no. 4, 522 pp. Rio de Janeiro, 1946.

Roark (R. C.). **How Foreign Countries carried on early DDT Investigations. A Review of Research Work on DDT throughout the World and a Compilation of Test Results.**—*Agric. Chem.* **1** no. 3 pp. 21–23, 57–61 ; no. 4 pp. 29–32, 156 refs. New York, N.Y., 1946.

GELORMINI (N.). **Bionomía del *Boophilus microplus*. Contribución inicial a su estudio.** [A preliminary Contribution to the Study of the Bionomics of *B. annulatus microplus*.]—115 [+2] pp., 6 pls. Buenos Aires, the Author, 1940.

The following is based on the author's summary of the results of a detailed study of the effects of temperature and humidity on females of the Ixodid, *Boophilus annulatus microplus*, Can., which transmits piroplasmosis and anaplasmosis of cattle in northern Argentina. Of females kept at various temperatures and humidities, all oviposited at 20–40°C. [68–104°F.] and 78–97 per cent. relative humidity, and 35 per cent. oviposited at 0–19°C. [32–66·2°F.] and 48–97 per cent. The preoviposition period after detachment ranged from a minimum of 4·25 days at 32–33°C. [89·6–91·4°F.] and 36–88 per cent. relative humidity to a maximum of 44 days at 0·25°C. [32–77°F.] and 48–98 per cent., with an average of 10·18 days. The maximum number of eggs laid per female in 24 hours was 750 at 38°C. [100·4°F.] and 80–95 per cent. humidity; the greatest numbers were generally laid 3–5 days after the beginning of the oviposition period, which lasted for up to 44 days. The greatest total number of eggs laid by one female was 3,230, at 17–26°C. [62·6–78·8°F.] and 78–100 per cent. humidity. In general, all processes were speeded up by higher temperatures and retarded or even stopped by lower ones; increased humidity or rainfall caused increased oviposition. The maximum duration of life was 66 days; under normal conditions females that left the host in April and May lived longest and those that did so in December had the shortest life. Most of the ticks died 5–10 days after completing oviposition, but one survived for 35 days after.

DEL VECCHIO (G.) & DEL VECCHIO (V.). **Prime osservazioni sull'anofelismo in provincia di Salerno.** [Preliminary Observations on Malaria in the Province of Salerno.]—*Boll. Soc. ital. Biol. sper.* **22** no. 1–2 pp. 7–8. Naples, 1946.

An Anopheline survey was carried out in 1943–45 in nine communes of the Province of Salerno in which malaria is endemic. Identification of eggs laid by 3,049 females taken during the three years in animal quarters and houses, showed that *Anopheles maculipennis*, Mg., var. *labranchiae*, Flni., *A. m. messeae*, Flni., and *A. m. sacharovi*, Favr (*elutus*, Edw.) represented 48·7, 33 and 11 per cent. of the population, respectively. *A. superpictus*, Grassi, represented only 0·5 per cent. but was the predominant Anopheline in some localities. Others present in small numbers were *A. m. typicus*, *A. m. atroparvus*, Van Thiel, *A. m. melanoon*, Hackett, *A. claviger*, Mg., and *A. plumbeus*, Steph. There was an evident association of malaria with *A. m. labranchiae* and *A. m. sacharovi*, which occurred along the coast, where breeding-places of high saline content were available.

CORRADETTI (A.) & ARCHETTI (I.). **Missione biologica Sagan-Omo diretta dal prof. Edoardo Zavattari: Diptera, Culicidae-Anophelini.**—*Riv. Biol. colon.* **7** pp. 115–118, 1 ref. Rome, 1946.

The Anophelines taken in southern Abyssinia in the summer of 1939, in the course of observations in the territory between the lower reaches of the Sagan and Omo rivers, which flow into Lakes Stephanie and Rudolf, respectively, comprised *Anopheles* (*Myzomyia*) *gingeroi*, sp. n., which is described from the one larva taken, and *A.* (*M.*) *rhodesiensis*, Theo., *A.* (*M.*) *gambiae*, Giles, and *A.* (*M.*) *pharoensis*, Theo., of which larvae only, larvae, pupae and adults, and adults only were observed. Notes are given on their distribution.

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Coutinho (J. O.) & Ricciardi (I.). **Contribuição para o estudo dos vetores de malaria no Brasil.** *Anopheles* (*Nyssorhynchus*) *darlingi* **Root, em Campos, no Estado do Rio.** [A Contribution to the Study of the Vectors of Malaria in Brazil. *A. darlingi* in Campos, Rio de Janeiro.]—*Mem. Inst. Osw. Cruz* **42** fasc. 1 pp. 263–280, 17 refs. Rio de Janeiro, 1945. (With a Summary in English.)

Investigations on the Anophelines of the district of Campos in the State of Rio de Janeiro, Brazil, were carried out in June and July 1944. The city of Campos and the town of Guarus are situated on either side of the Paraíba River, in low-lying country intersected by ditches, pools and a canal, near the coast but beyond the influence of the tides. The malarial index in both towns was high, the total numbers of locally acquired cases being 601 in 1943 and 694 in the first half of 1944. The results of the investigations are shown in numerous tables. In nocturnal captures using animal bait, 1,236 Anophelines were taken in about 40 hours. Of these, 956 were *Anopheles albitarsis*, Lynch Arrib., and 266 *A. triannulatus*, Neiva & Pinto ; the remainder were *A. darlingi*, Root, *A. noroestensis*, Galvão & Lane, and *A. oswaldoi*, Peryassú. In houses, 309 Anophelines were taken at night, comprising 175 of *A. darlingi*, 100 of *A. albitarsis*, and 34 of *A. triannulatus* ; only 111 were taken by day, the same three species being present in similar proportions. *A. triannulatus* was usually taken in houses in which animals were lodged under the same roof as man. Dissection of captured females showed oöcysts on the stomachs of 6·8 per cent. of *A. darlingi* and 2 per cent. of *A. albitarsis*, and sporozoites in the salivary glands of 4 per cent. of *A. darlingi* and none of *A. albitarsis* ; no infection was found in *A. triannulatus*. *A. darlingi* was thus the chief vector.

All accumulations of water in Campos and in a belt $1\frac{1}{4}$ miles wide round it were examined for larvae ; 15,566 were taken, of which 13,195 were sufficiently mature to be identified. They belonged to the species *A. albitarsis*, *A. triannulatus*, *A. darlingi*, *A. noroestensis*, *A. pessôai*, Galvão & Lane, *A. aquasalis*, Curry (*tarsimaculatus*, auct.), *A. oswaldoi* and *A. intermedius*, Chagas, of which the first three represented about 84·8, 11·2 and 3·6 per cent., respectively, of the total. The preferred breeding places of *A. darlingi* are discussed from the literature [*cf. R.A.E.*, B **31** 112 ; **34** 33] ; the majority of those observed were in lakes, but the larvae were present in great numbers in the canal, and were found in large and small volumes of clear or turbid water, under widely varying conditions, usually in association with *A. albitarsis* or *A. triannulatus*.

Bustamante (M. E.) & Varela (G.). **III. Estudios de fiebre manchada en México. Hallazgo del** *Amblyomma cajennense* **naturalmente infectado, en Veracruz.** [Studies of Spotted Fever in Mexico. III. Discovery of *A. cayennense* naturally infected, in Vera Cruz.]—*Rev. Inst. Salub. Enferm. trop.* **7** no. 2 pp. 75–78, 1 map, 10 refs. Mexico, D.F., 1946. (With a Summary in English.)

In this paper, which is one of a series [*cf. R.A.E.*, B **36** 53, etc.], it is stated that examples of *Amblyomma cayennense*, F., taken in the State of Vera Cruz, Mexico, were found to be infected with spotted fever. Injection of the crushed ticks caused an infection in guineapigs, and the strain of rickettsiae isolated gave positive results in cross-immunity tests with other Mexican strains, but did not confer immunity from murine typhus. The infection was less severe than that transmitted by *Rhipicephalus sanguineus*, Latr., in Sonora and Coahuila, and is thought to correspond to the eastern type of spotted fever in the United States. The geographical distribution of *A. cayennense* in Mexico is described, and that of spotted fever there shown on a map.

VARGAS (L.). **El *Anopheles darlingi* Root, 1926 en México.**—*Rev. Inst. Salub. Enferm. trop.* **7** no. 4 pp. 221–226, 10 refs. Mexico, D.F., 1946. (With a Summary in English.)

The author describes all stages of *Anopheles darlingi*, Root, and states that whereas it was not previously known to occur further north than the frontier between Guatemala and Mexico [*cf. R.A.E.*, B **32** 14], it has recently been taken in Mexico at Teapa, Tabasco. This place is in the middle of a hot, damp well-watered region that extends round the coast as far as Tampico in Tamaulipas to the north and Champotón in Campeche to the east, so that the species may have a still wider distribution. A list is given of the ten species of *Anopheles* known from Tabasco.

WESTPHAL (E. A.) & HORTON (R. K.). **Malaria Control Work in Chimbote, Peru.**—*Bol. Ofic. sanit. panamer.* **25** no. 9 pp. 796–809, 5 figs. Washington, D.C., 1946. (With a Summary in Spanish.)

The scheme for the development, as an industrial port, of Chimbote, a small town on the coast of Peru about 250 miles north of Lima, has necessitated measures for the improvement of public health and sanitation, including work on the prevention and control of malaria. A medical survey carried out in May 1942 showed that, of 472 children between the ages of five and 12 years, 9·1 per cent. had malaria parasites in their blood and 24·6 per cent. had enlarged spleens, and large numbers of larvae of *Anopheles pseudopunctipennis*, Theo., were found in the extensive lagoons on the north and east sides of the town, which afforded large areas of fresh water wholly exposed to the sun and covered with algae or other aquatic vegetation and thus favoured breeding [*cf. R.A.E.*, B **34** 148]. A few larvae of *A. punctimacula*, D. & K., were found in one isolated spot, but were not numerous enough to be important.

The eastern lagoon consisted of a number of separate lakes with a total surface of about 60 acres; the northern ones, which were interconnected, covered 156 acres. Both were ground-fed, and there is practically no rainfall in the district. While the possibilities of effecting permanent control by draining these lagoons to a distance of 1½–2 miles from the town were being investigated, temporary control measures were begun in 1942. Prophylactic atabrine was made available to the community, and a larvicidal campaign was carried out. The lagoons were cleared of débris and vegetation, including reeds, and since Paris green was not available in sufficient quantities, they were sprayed with a mixture of tricalcium arsenite (79·3 per cent. pure) and kerosene (1 : 2) diluted with water at the site in proportions varying from 1 : 150 to 1 : 300, the actual amount of tricalcium arsenite applied varying from 6 to 17 cc. per 100 sq. metres. In a few instances the arsenite was applied as a dust, the diluent being a fine road dust, but the spray was slightly more effective. At first all breeding places were sprayed weekly, but the work was decreased gradually as the construction of drainage channels proceeded, until the campaign was closed in November 1944. Weekly counts showed that the larval population of the lagoons was reduced from an average of 8–10 larvae per dip before the campaign to 0·2–0·3 per dip while it was in progress, and weekly captures of Anophelines in three houses in the town were reduced from 5–30 to 0–6 per half hour period; catches in animal traps also showed reductions of 60–100 per cent. The percentages of children with blood parasites and enlarged spleens were reduced to 5·9 and 19·7, respectively, and there was no epidemic after the control work had begun, although several thousand persons had moved into the area, many of them from non-malarious regions.

A detailed account is given of the permanent measures taken to drain the lagoons, which resulted in a reduction of 90–95 per cent. in the areas suitable for

the breeding of *A. pseudopunctipennis*. A complete survey of the effects on the incidence of malaria was to be undertaken.

MACCHIAVELLO (A.), MOSTAJO (B.) & MOSTAJO hijo (B.). **Control de una epidemia de peste bubónica con DDT y " 1080 ".** [An Outbreak of Bubonic Plague controlled by DDT and Sodium Fluoracetate.]—*Bol. Ofic. sanit. panamer.* **25** no. 12 pp. 1097–1100. Washington, D. C., 1946. (With a Summary in English.)

An outbreak of plague occurred in Tumbes, Peru, late in 1945. This town is largely built of bamboo or wattle and contained large numbers of *Mus* (*Rattus*) *rattus alexandrinus*, with a flea index of 4·5 per rat and an average of 5·03 fleas per nest, the fleas concerned in both cases being mainly *X*[*enopsylla*] *cheopis*, Roths. This species also occurred on the floors of houses, though there it was outnumbered by others, and in patients' clothes. The temperature was between 26 and 34°C. [78·8–93·2°F.] and the relative humidity 75–94 per cent. In all, 21 foci of murine plague were found, in which 27·3 per cent. of the rats and 56 per cent. of the fleas on them or in their nests were infected. There were 40 human cases, with 14 deaths. The floors of all the houses were first dusted with 10 per cent. DDT in talc or pyrophyllite, to prevent further transmission to man, and then the ceilings and the spaces below floors, behind walls and above ceilings, with 5 per cent. DDT in refined wheat flour, which reduced the flea index and the average number of fleas per nest to 0·83 and 0·61, respectively. The whole treatment was subsequently repeated and the flea index further reduced to 0·755. At the same time, poisoned baits were distributed against the rats. The outbreak ceased four days after the treatment, though one case occurred a month later in an incompletely treated focus.

SANDOSHAM (A. A.). **Identification of the common Malayan Anophelines.**—[1 +]25 pp., text ill. Singapore, 1945. **The Identification of the common Anophelines of Malai and Thailand.**—9½ × 6 ins., 95 pp., 7 pls., 2 fldg. charts, text ill. Syonan [Singapore], Syonan Tokubetu-Si, 1945.

The first booklet comprises data on the morphology of the various stages of *Anopheles* in general and illustrated keys for the identification with simple equipment of the larvae and adults of both sexes of the 17 species of that genus that are common or important in Malaya, together with brief notes on their morphology, prevalence, biology and status as vectors of malaria there [*cf. R.A.E.*, B **36** 91].

The second includes also most of the other information on *Anopheles* (except control measures) contained in the author's recent monograph on malaria in Malaya [*loc. cit.*] and in addition a list of the species and subspecies recorded in Siam and a summary of the available information on the morphology, prevalence, bionomics and status as vectors of malaria of ten species or subspecies common, widespread or important in Siam but not in Malaya. The keys to the larvae and females are amended to include these ten forms. The distribution of malaria and its probable vectors in Siam are discussed, mainly from the literature [**21** 89–91 ; **25** 188]. Intense malaria in the hilly districts to the west of the central plain is associated with the breeding of *A. fluviatilis*, James, *A. culicifacies*, Giles, and *A. minimus*, Theo., and 14 or 15 other species occur in the area, including *A. barbumbrosus*, Strickl. & Choudh., and *A. insulaeflorum*, Sw. & Sw., which are recorded from Siam for the first time.

BATES (M.) & ROCA-GARCIA (M.). **Laboratory Studies of the *Saimiri-Haemagogus* Cycle of Jungle Yellow Fever.**—*Amer. J. trop. Med.* **25** no. 3 pp. 203–216, 2 figs., 23 refs. Baltimore, Md., 1945.

Though a theory had been formulated that the virus of jungle yellow fever in eastern Colombia was maintained by mammal to mammal passage through

mosquito vectors, chiefly *Haemagogus capricorni*, Lutz [*R.A.E.*, B **32** 183–184 ; **34** 196], difficulty had been experienced in reproducing the postulated mechanism in the laboratory, chiefly because of the difficulty of maintaining *H. capricorni* [**20** 270 ; **26** 65–66] but also because of the insufficiency of knowledge of the behaviour of various strains of the virus and the mammals involved. A standard procedure is here described by which the virus was carried through five laboratory cycles with monkeys of the genus *Saimiri* as the host and *H. capricorni* as the vector. Attention is centred on the mosquito part of the cycle.

There has been no indication of the presence of yellow fever virus in the study areas since 1940, and female mosquitos caught in nature were used in most of the experiments. They were brought to the laboratory and kept throughout the experiment in individual tubes, and were stored at 20 or 25°C. [68 or 77°F.] and allowed to feed singly on the source animals within 48 hours of capture, usually on the palms of the hands and feet, but sometimes on the shaved abdomen. Females that failed to engorge were destroyed. The ingestion of the virus by the others was checked by bleeding the source animal and inoculating decimal dilutions of serum into adult mice and by injecting 3–5 engorged mosquitos intracerebrally into adult mice. The remaining mosquitos were kept in individual flat-bottomed vials about 25×50 mm. in size with a layer of moist cotton covered by a disk of filter paper in the bottom and a cup of aluminium wire gauze containing a little absorbent cotton moistened on alternate days with weak sugar solution as a plug. Frequent transference to clean vials seemed unnecessary if the bottom layer of cotton was kept suitably moist. Allowing it to become too wet or too dry, and other apparently trivial details, caused mortality to increase.

The strain of virus used had been subject to a minimum of laboratory manipulation. Adult white mice of the standard strain used in yellow-fever studies showed an irregular susceptibility to intracerebral inoculation of small amounts of it, but mice three and five days old were highly susceptible. The behaviour of the virus in the mice is discussed. It was highly virulent to *Saimiri* monkeys caught in nature locally. Ten out of 18 on which infected mosquitos fed became infected, and eight of these died in the course of acute infections. The other two had mild infections, atypical in several respects. There was evidence that this virulence was an adaptive character of the strain. The procedure used in testing the monkeys for infection is described.

The incubation period of the virus in *H. capricorni* under the conditions of the experiments was 22–24 days at a fluctuating temperature of 24–27°C. [75·2–80·6°F.] and 13–15 days at a constant temperature of 30°C. [86°F.] [*cf.* **19** 214 ; **26** 143]. Only a proportion of females acquired the infection, the percentage doing so apparently depending on the amount of virus ingested and the temperature at which the mosquitos were kept. It was much higher at 30°C. than at lower temperatures. The possible effect of virus strain and of the genetic constitution of the mosquitos was not studied.

The epidemiological implications of the results obtained are discussed. Field studies in eastern Colombia have indicated *H. capricorni* as the primary vector, but it appears that the dominant mammalian host, if any, may vary from region to region [**32** 183]. The distribution of yellow fever does not correspond with that of *Saimiri* monkeys. However, the *Saimiri-Haemagogus* cycle is probably a natural one, though perhaps not dominant. Sera of 10 of 82 *Saimiri* monkeys taken in the Villavicencio and Restrepo areas in 1944 gave clearly positive results in protection tests. Most came from a region where there were several known human cases of yellow fever during the year. *Callicebus* and *Cebus* monkeys from the same area gave about the same proportion of positive results. If the high mortality rate observed in the laboratory among *Saimiri* monkeys occurred in nature and these were a dominant host, a great reduction in their

numbers would be expected. Yet they are apparently the commonest local primates. The high mortality rate may explain the relatively low protection rate, or it may not occur in nature. The view that the *Saimiri-Haemagogus* cycle occurs in nature in eastern Colombia is supported by the facts that *Saimiri* monkeys are the only local mammals from which a high titre of virus has been consistently recovered, and a high titre is apparently necessary to infect *H. capricorni*. *H. capricorni* is the commonest local Aëdine, and both it and the monkey are predominantly arboreal and diurnal and are common in a wide variety of local forest types through which cases of yellow fever are equally generally distributed. Day temperatures are appreciably higher in the forest canopy than in the lower forest strata. Shade temperatures of 30°C. are rare, but the female mosquitos may spend part of the incubation period of the virus in sunny situations. *H. capricorni* was very resistant to high temperatures in the laboratory.

WADDELL (M. B.) & TAYLOR (R. M.). **Studies on cyclic Passage of Yellow Fever Virus in South American Mammals and Mosquitoes. Marmosets** (*Callithrix aurita*) **and Cebus Monkeys** (*Cebus versutus*) **in Combination with** *Aëdes aegypti* **and** *Haemagogus equinus*.—*Amer. J. trop. Med.* **25** no. 3 pp. 225–230, 3 figs., 13 refs. Baltimore, Md., 1945.

An account is given of laboratory experiments on the transmission of jungle yellow fever in which a Brazilian strain of virus was maintained in serial passage for nine cycles with a marmoset (*Callithrix aurita*) as the host and *Aëdes aegypti*, L., as the vector, another virulent Brazilian strain was maintained for five cycles and a mild Colombian strain for two cycles with *Cebus* monkeys (*C. versutus*) as the host and *A. aegypti* as the vector and the first Brazilian strain was maintained for three cycles with the marmoset as the host and *Haemagogus equinus*, Theo., as the vector. The third series was interrupted through an accident to the test moquitos and the fourth for lack of fresh ones. *Callithrix* and *Cebus* are the two widely distributed genera of primates in Brazil.

In no case did a marmoset exposed to *A. aegypti* fail to become infected, and of the 17 animals so exposed, 15 died. Both the survivors were immune 21 days after exposure. Virus circulated for four and five days, respectively, in these animals and until death in the others. The period elapsing between the mosquitos' infective meal and the time they were allowed to feed on a normal experimental animal varied from 19 to 73 days, and the number of mosquitos used in making the passages from four to 120. All the *Cebus* monkeys exposed to the virulent strain showed circulating virus and all those that recovered developed immunity. Only two out of 13 died, one from intercurrent infection. The period between the infective and test feeding varied from 26 to 52 days and the number of mosquitos used from 15 to 143. Circulating virus was present in *Cebus* monkeys 3–5 days after infection and sometimes as much as 7 days after it, but the concentration was low compared with that found in marmosets. Not all the experimental monkeys circulated the mild strain in concentrations adequate to infect mosquitos consistently. Five of eight marmosets fed on by *H. equinus* showed circulating virus and died. The others neither showed circulating virus nor developed immunity. This may have been because the mosquitos were used too soon or in inadequate number on account of the difficulty of maintaining individuals of this genus in the laboratory [*cf.* preceding abstract]. Females of *H. equinus* were reared and maintained following infection at 26–28°C. [78·8–82·4°F.] and a relative humidity of 70-90 per cent. Three females of *H. spegazzinii*, Brèth., a species found in regions where jungle yellow fever is endemic in Brazil [*R.A.E.*, B **35** 121], transmitted the virus from an infected to a normal marmoset.

The importance of these observations in relation to the epidemiology of jungle yellow fever in South America is briefly discussed, and it is considered possible that the virus may be maintained in the form of wandering epidemics in forested areas in which there are adequate populations of marmosets or *Cebus* monkeys and an effective vector.

NEWTON (W. L.), WRIGHT (W. H.) & PRATT (I.). **Experiments to determine potential Mosquito Vectors of *Wuchereria bancrofti* in the continental United States.**—*Amer. J. trop. Med.* **25** no. 3 pp. 253–261, 12 refs. Baltimore, Md., 1945.

The experiments described were made in view of the prevalence of filariasis in many areas in which United States forces were operating and the possibility of individuals returning to the continental United States being infected with the disease [*cf. R.A.E.*, B **35** 139]. The literature on the suitability as hosts for *Filaria* (*Wuchereria*) *bancrofti* of species of mosquitos occurring in the United States is reviewed [**8** 116; **20** 159; **22** 104; **23** 116; **26** 95]. The investigations were begun in Porto Rico and continued in Alabama. Adult mosquitos were bred from larvae and pupae collected in the field and allowed to feed on volunteers infected with the periodic strain of *F. bancrofti*. The two methods of feeding used and the success attained with each of the 17 species tested and its United States distribution and prevalence are described. The volunteers had average counts of 42, 54 and 60 microfilariae in 20 cu. mm. of blood drawn from the finger at 8.30 p.m. All the species used except *Culex restuans*, Theo., fed, and 1,801 females of 15 species were dissected, 696 that were dead or moribund 2–9 days after feeding and the others at various intervals 9½ days or more after feeding. The results for both groups are given in a table. Discussions of infectibility are based on females dissected after 9½ days or more only. All of 17 such females of *Culex fatigans*, Wied. (*quinquefasciatus*, auct.) showed larvae that had developed to the infective stage, and nine had larvae in the head or proboscis. *Anopheles albimanus*, Wied., carried infective-stage larvae in 35 per cent. and well advanced larvae in 32 per cent. of the females examined, giving a total infectibility rate of 67 per cent. Of the 40 containing infective larvae, 24 had them in the head or proboscis. Of the females of *Psorophora confinnis*, Lynch Arrib., examined from the continental United States, 60 per cent. contained infective larvae and 20 per cent. well-advanced larvae, giving a potential infectibility rate of 80 per cent.; 45 of the 63 with infective larvae had head or proboscis infection. Complete development of the larvae was observed occasionally in *P. confinnis* collected in Porto Rico, *C. nigripalpus*, Theo., *Aëdes aegypti*, L., and *A. triseriatus*, Say, which had infectibility rates of 12, 6·8, 4·9 and 2·8 per cent., respectively. No development beyond the first larval stage was observed in *A. sollicitans*, Wlk., *A. taeniorhynchus*, Wied., *A. vexans*, Mg., and *Anopheles punctipennis*, Say. Inconclusive evidence was obtained for *A. quadrimaculatus*, Say, *C. erraticus*, D. & K., *C. salinarius*, Coq., *P. ciliata*, F., and *P. discolor*, Coq. The data indicated that none of these species is a good host, with the possible exception of *P. discolor*, in which the infective stage occurred in one female and well-advanced stages in five others. The development of the filarial larvae is described. It followed the lines recorded by other investigators. The infective stage was reached in most mosquitos within two weeks, but in *C. fatigans* development was completed on an average 2–4 days sooner. There were indications of a general migration towards the head and proboscis.

It is concluded that *C. fatigans*, *P. confinnis* and *A. albimanus* could be excellent vectors of *F. bancrofti*, should the proper conditions prevail for the spread of filariasis. *C. fatigans* is indicated as the most important potential vector in view of its tendency to breed in urban areas. *C. nigripalpus*, *Aëdes*

aegypti and *A. triseriatus* might act as vectors, although their low infectibility rates preclude their playing an important part in the spread of the disease. *A. sollicitans*, *A. taeniorhynchus*, *A. vexans* and *Anopheles punctipennis* appear unable to transmit the infection.

LYLE (C.). **Achievements and Possibilities in Pest Eradication.**—*J. econ. Ent.* **40** no. 1 pp. 1–8, 2 refs. Menasha, Wis., 1947.

The author gives chronological lists of insects and a few other invertebrates that have been eradicated in the United States or elsewhere, with very brief notes on the circumstances. Some of them are of medical or veterinary importance. He considers that more attention should be given to such work and discusses a few other insects of which the eradication from the United States would be desirable and might be possible.

EDDY (G. W.). **Effect of Humidity on the Toxicity of certain organic Compounds to Eggs of the Body Louse.**—*J. econ. Ent.* **40** no. 1 pp. 116–118, 5 refs. Menasha, Wis., 1947.

The following is mainly based on the author's summary. The toxicity of MYL louse powder, which is composed of 0·2 per cent. pyrethrins from a 20 per cent. concentrate, 2 per cent. N-isobutyl-undecylenamide, 2 per cent. 2,4-dinitroanisole and 0·25 per cent. Phenol S (chiefly isopropyl cresols) in pyrophyllite [*cf. R.A.E.*, B **34** 45], and of m-nitroacetophenone, azoxybenzene, 2,4-dinitroanisole (the ovicide in MYL), diphenylamine, 2,4-dinitrophenol, thymol, formanilide, piperonal and ethyl p-aminobenzoate, all at 10 per cent. in pyrophyllite, to eggs of *Pediculus humanus humanus*, L. (*P. h. corporis*, Deg.) was shown to be greatly affected by atmospheric moisture [*cf.* **33** 172]. Eggs 4–6 days old were more resistant than eggs less than two days old, but in general the materials gave excellent kill at relative humidities of 80 per cent. or higher, but little or no kill at 63 per cent. or lower. The toxicity of some compounds was more affected by atmospheric moisture than that of others, but no correlation was noted between the solubility of the compound in water and the effect of relative humidity on toxicity to eggs.

Extremely low humidities did not prevent the hatching of normal eggs. Some mortality occurred when eggs were kept in closed desiccators over water and became affected by moulds, but little mortality was observed when the eggs were dipped in alcohol and handled under aseptic conditions. The addition of 1 per cent. of the hygroscopic materials, glycerol and dipropylene glycol, to 5 per cent. 2,4-dinitroanisole and ethyl p-aminobenzoate, respectively, in pyrophyllite did not affect the kills caused by these compounds over a range of humidities. Ovicides were more effective when applied in solution in alcohol than as powders, but when concentrations were low, mortalities varied with humidity, though its effect was not so marked.

MADDEN (A. H.), SCHROEDER (H. O.) & LINDQUIST (A. W.). **Residual Spray Applications to Salt-marsh and Jungle Vegetation for Control of Mosquitoes.**—*J. econ. Ent.* **40** no. 1 pp. 119–123, 2 refs. Menasha, Wis., 1947.

Application of sprays to leave a toxic residue for the control of adult salt-marsh mosquitos (chiefly *Aëdes taeniorhynchus*, Wied., and *A. sollicitans*, Wlk.) was tested on the open marsh and in the jungle in Florida in 1945. The salt-marsh tests were undertaken with a view to killing newly emerged adults or gravid females. DDT at 5 per cent. in suspension in water and in oil solution and emulsified solution was applied with hand-operated pressure sprayers at 5–30 U.S. gals. spray per acre. The results obtained by exposing adults of *Musca domestica*, L., and *Anopheles quadrimaculatus*, Say, for 24 hours to

samples of vegetation collected in the plots at various intervals up to seven weeks or more after treatment are shown in tables. They were somewhat inconsistent, but together with direct observations on populations and trapping records, they indicated that such treatments had promise. The suspension appeared to be the least effective material at the lower dosages. Reduced kill by high dosages of solutions and emulsions after a few weeks is attributed to scorching of vegetation, which led to regrowth and consequent reduction in the proportion of surface treated. Medium dosages thus appear to be the most satisfactory.

The jungle tests were made to compare the effectiveness of 1 per cent. pyrethrins activated with 5 per cent. piperonyl cyclohexanone in kerosene, an aqueous emulsion containing 5 per cent. benzene hexachloride (12 per cent. γ isomer), and a suspension containing 5 per cent. DDT with that of a solution of 5 per cent. DDT in fuel oil. The sprays were applied at 5 U.S. gals. per acre to surface litter and vegetation up to a height of about 5 ft. Results were determined mainly by counting the numbers of mosquitos landing on the clothing of the observer in a given time in treated and adjacent untreated areas. The four treatments were estimated to effect 60, 70, 88 and 86 per cent. control, respectively, after 5 days and 20, 26, 64 and 41 per cent. after 53 days. The superiority of the DDT suspension over the solution became apparent after 26 days. Pyrethrum and benzene hexachloride lost effectiveness after 26 days, but at an equal dosage of active ingredient, the latter might be as effective as the DDT suspension [*cf. R.A.E.*, B **36** 9]. Percentage mortalities obtained when adults of *Musca domestica* were exposed for 3 and 15 hours to vegetation and débris collected from the treated plots 33 days after spraying were 0 and 5 for pyrethrum, 0 and 8 for benzene hexachloride, 98 and 100 for DDT suspension and 79 and 99 for DDT solution. Treatments were not so effective on the marsh as in the jungle. This is attributed in part to the effects of sunlight [**35** 90], but the main reason appears to be that the density and physical properties of the marsh vegetation do not permit so thorough a treatment as is possible in jungle.

O'Kane (W. C.). **Results with Benzene Hexachloride.**—*J. econ. Ent.* **40** no. 1 pp. 133–134. Menasha, Wis., 1947.

Brief results are given of preliminary tests in New Hampshire on the toxicity of benzene hexachloride, chiefly as a dust in an inert carrier, to a large number of insects, mostly plant pests [*cf. R.A.E.*, A **36** 233–235] but including the American cockroach [*Periplaneta americana*, L.], the head louse [*Pediculus humanus capitis*, Deg.] and mosquito larvae (*Aëdes* spp.). Dusts containing 0·5 and 1 per cent. γ isomer gave good control of the cockroaches, and the 1 per cent. dust drove them out of cracks. One application of a dust containing 0·5 per cent. γ isomer to the surface of water at 10 lb. per acre apparently gave complete control of larvae of *Aëdes* spp., including *A. aegypti*, L. One application of the 1 per cent. dust is reported to have controlled an infestation of head lice. The head was kept bound for 2–3 hours. Irritation by lice ceased in 20 minutes.

Portman (R. W.). **Dipping in Benzene Hexachloride to control** *Amblyomma americanum*.—*J. econ. Ent.* **40** no. 1 pp. 134–135. Menasha, Wis., 1947.

In tests in Missouri in 1946 on the control of *Amblyomma americanum*, L., on stock cattle with sprays and dips prepared from a wettable powder containing 50 per cent. benzene hexachloride (10–13 per cent. γ isomer), a spray containing 1 per cent. benzene hexachloride and a dip containing 0·5 per cent. gave complete kill of all stages and protected the treated animals for 7–10 days in spite of heavy rain. A 0·25 per cent. dip was too weak to kill any of the ticks. Spraying with a pressure machine was slower and gave less good coverage than dipping. A calf showed no effect other than increased appetite from ingesting the

amount of benzene hexachloride that it was estimated it might get when sucking a dipped animal. Swabbing dairy cows with 0·5 per cent. benzene hexachloride immediately after milking imparted no odour or taste to the milk from later milkings and was as effective as dipping against the tick. The numbers of horn flies [*Siphona irritans*, L.] worrying cattle were greatly reduced after dipping.

Entomological Investigations.—*20th Rep. Coun. sci. industr. Res. Aust. 1945–46* pp. 18–24. Canberra, 1946. **Animal Health and Production Investigations.** —*T. c.* pp. 24–31.

This report includes accounts of experiments in Australia on the control of the cattle tick [*Boophilus annulatus microplus*, Can.] and *Siphona exigua*, de Meij., by dipping or spraying with preparations containing DDT [*R.A.E.*, B **36** 101–105]. Solutions containing 12, 8 and 4 per cent. DDT, applied to the whole body as fine sprays at 2–4 fl. oz. per animal, killed the tick and gave protection from reinfestation for 7, 6¼ and 5½ days, respectively. In three months, no ill effects were observed in either of two groups of cattle (one receiving a high-grade diet and the other a low-grade one), that were having 22·5 gm. DDT per animal in oil solution applied weekly to the skin. An attempt to find an adequate schedule for using arsenical dips to reach all ticks in the most vulnerable stages had shown that three dippings in six days in a mixture of arsenic and nicotine sulphate were necessary to clear cattle of ticks and this would probably harm the animals in hot weather. It has been shown that *S. exigua* can be effectively controlled in dairy herds by using glass-walled traps treated with DDT [**35** 117, but *cf.* **36** 103], by spraying lightly in the bails every two or three days with a 4 per cent. solution of DDT in power kerosene [**36** 102] or by spraying the shoulders of about half the animals every three weeks during the season with 2–4 fl. oz. of an emulsion containing 2 per cent. DDT or with 0·5 per cent. DDT as Rucide. Spraying is recommended for dry stock or for beef cattle that are handled sufficiently often. Treatment after dipping has been found sufficient [**36** 103].

Adults of *M*[*elophagus*] *ovinus*, L. were destroyed on the first few sheep dipped in an emulsion containing DDT at 1 : 2,000, but some survived on sheep dipped thereafter [*cf.* **35** 71, 195 ; **36** 56] ; the concentration declined by about 50 per cent. after 24 sheep had passed through 30 gals. [*cf.* **36** 93]. In six small field trials, benzene hexachloride (10–13 per cent. γ isomer) in emulsified solution at 1 : 3,000 and 1 : 6,000 killed all keds present at the time of dipping [*cf.* **35** 195], but those that emerged from pupae present at dipping survived on the later dipped sheep. The dip was effective against *Damalinia* (*Bovicola*) *ovis*, L., at 1 : 2,000. The life-cycle of this louse on the sheep was found to approximate that found *in vitro* at 36·5°C. [97·7°F.] and 50–70 per cent. relative humidity. Development from hatching to adult lasted 22 days, the pre-oviposition period 4 days, and the egg stage 8–10 days. In insectary tests, limited areas on the backs of long-woolled sheep were treated with coarse sprays, containing DDT in suspension or in emulsified or unemulsified oil solution, cotton-wool plugs in indole and ammonium carbonate solution, which stimulates oviposition, were tied on treated and untreated parts of the fleece and the sheep were exposed to a dense population of ovipositing females of *Lucilia cuprina*, Wied., at intervals until there was no difference in the number of eggs laid on test and control plugs. Almost complete protection from oviposition for 4–6 weeks was given by 1 or 2 per cent. DDT in kerosene or in emulsion, but suspensions were less effective. Benzene hexachloride appeared to give considerably less protection than equivalent concentrations of DDT. The surgical removal of skin from the tail has been found to withdraw wool-bearing skin from the sides and tip and thus avoid urine-staining, but no field

trials have yet shown the effect of this on the incidence of tail strike. Further trials have confirmed the value of dressings containing boric acid, citronella and bentonite at lamb marking [*cf.* **35** 71]. Observations support the theory that " wrinkling " and " plain-body " are paired characters, the inheritance of which is mendelian and multi-factor [*cf.* **35** 71].

In tests of the toxicity in water of 18 acetone extracts of Australian plants to fourth-instar larvae of *Aëdes aegypti*, L., the best results were obtained with the leaves of *Piper novae-hollandiae*, which with three other extracts gave more than 50 per cent. kill in 24 hours at a concentration of 4 : 1,000 based on original air-dry weight. A rapid knockdown of mature females of *Latrodectus hasselti*, Thorell, with no recovery, was obtained by exposing them to a spray containing 0·1 per cent. pyrethrins.

GÓMEZ (L.). **Revisión crítica de los casos de oftalmomiasis españolas.** [A critical Revision of the Cases of Ocular Myiasis in Spain.]—*Rev. ibér. Parasit.* **6** no. 1–2 pp. 51–73, 2 pls., 2½ pp. refs. Granada, 1946.

In view of a case of ocular myiasis due to *Oestrus ovis*, L., in man in Granada in 1945, the author gives a list of about a dozen such cases that have been recorded in Spain since 1918. The identity of the larvae concerned is not certain in every one, but *O. ovis* appears to be the fly most frequently responsible, though it has sometimes been misidentified ; only one case was certainly due to *Rhinoestrus purpureus*, Brauer. The first-instar larvae of these two flies, which have sometimes been confused [*cf. R.A.E.*, B **10** 54], are described, that of *R. purpureus* from the work of Portchinsky [**3** 217], and characters are given distinguishing them. The larvae of *O. ovis* observed in Granada and those described by Coulon & Dinulescu from Corsica [**19** 160] are considered to represent different varieties, which are distinguished by the form of the spiracles as vars. *granatae* and *corsicae*, n.

NÁJERA (L.). **Observaciones sobre la ecología de los *Phlebotomos* en su fase larvaria principalmente.** [Observations on the Ecology of *Phlebotomus*, particularly in the larval Stage.]—*Rev. ibér. Parasit.* **6** no. 1–2 pp. 139–158, 19 figs., 30 refs. Granada, 1946.

The author reviews the literature on the preferred habitats and the feeding habits of *Phlebotomus* larvae [*cf. R.A.E.*, B **21** 219 ; **31** 164] and records that larvae of *P. papatasii*, Scop., and *P. perniciosus*, Newst., reared in 1943, fed on filter paper when this was impregnated with liquids from decaying organic substances. These larvae were obtained from eggs laid by captured females that were confined in glass tubes containing damp cotton-wool covered by a disk of filter paper. The tubes were covered with gauze and kept in a container placed on a layer of wet cotton-wool, which served to maintain a nearly saturated atmosphere. Most of the eggs were deposited on the damp filter paper, and as soon as they began to hatch, the disks were transferred to small unglazed earthenware dishes, containing plaster covered with a ¼-inch layer of pulped guineapig faeces [*cf.* **29** 188], and set in a large dish of wet sand under a bell-glass. Newly-hatched larvae left in the oviposition tubes did not feed on the filter paper, but usually crawled into the cotton-wool beneath it and did not survive beyond the third instar ; when the filter papers were placed on the faeces, the larvae devoured large areas of the paper.

In view of their polyphagous habits, the author concluded that the larvae of *Phlebotomus* would be able to develop in household refuse, which would explain their prevalence in the centres of large cities, such as Madrid, where adult sandflies have been found at a distance from gardens and parks. To test this theory, he investigated the sites of buildings in Madrid that were

destroyed in the civil war, many of which remained as derelict spaces where rubbish of all kinds was thrown. Between late 1942 and 1944, 148 samples of earth, each of about 2 oz., were taken from various sites and examined microscopically. *Phlebotomus* larvae were found in 5 of 67 samples in 1943 and in 9 of 63 in 1944, most of the positive samples being taken in June or September. A few pupal exuviae were also found. The clearance of waste areas in cities is recommended as a control measure.

Gomeza Ozámiz (J. M.). **El descubrimiento del nuevo insecticida 666.** [The Discovery of the new Insecticide 666.]—*Ion* **5** no. 53 pp. 745–750, 9 refs. Madrid, 1945.

The insecticidal properties of benzene hexachloride (666) were discovered in Spain independently of the work in England [*R.A.E.*, B **33** 130], which did not become known there until after the war, and were recognised in the course of investigations on various chlorine derivatives of benzene related to para-dichlorbenzene. Its effectiveness against insects of medical importance soon became evident and was recognised officially by the Ministry of War on 20th October 1945. The first tests on agricultural insects were made in February 1944. The chemical composition and properties of benzene hexachloride and its four known isomers and their boiling point are reviewed. Tests have shown that the γ isomer is the most toxic, followed by the δ and α isomers, in that order, while the β isomer is practically inactive. The effect of the compound on flying and crawling insects is described.

It is less toxic than DDT to man and warm-blooded animals, and no cases of poisoning in man due to its use have been observed. Its toxicity to insects has been thought to be due to its similarity to inositol [*cf.* **33** 131 ; **36** 99], and it is suggested that its ability to penetrate the integument, as well as that of DDT, which has been attributed to the chloroform group of the molecule [*cf.* **35** 101], may be due to the benzene radical. In tests, dusts and emulsified solutions of benzene hexachloride proved effective against larvae of *Anopheles* and *Culex*, a water suspension against the adults in tubes and against mosquitos in a fowl-house, which was kept free from infestation for more than a fortnight, and a dust against lice [*Pediculus humanus humanus*, L.] when applied to underclothes and bed-linen and against *Phthirus* (*Phthirius*) *pubis*, L., when applied to the affected parts of the body. A dust and a spray both killed *Ornithodoros* under experimental and natural conditions, proving more effective than DDT, a solution in benzene freed chicken perches from mites and Mallophaga, and a dust freed cattle from ticks and was slightly more effective than a spray.

Codeleoncini (E.). **Sulla presenza in Etiopia della** *Rickettsia weigli*. **Considerazioni sul rapporto fra la** *Rickettsia weigli*, **l'agente eziologico della "febbre delle trincee" e la** *Rickettsia pediculi*. [On the Presence in Abyssinia of *Rickettsia weigli* ; with Considerations on the Relationship between this Species, the Agent of Trench Fever and *R. pediculi*.]—*Boll. Soc. ital. Med.* (*Sez. Eritrea*) **6** no. 1–2 pp. 129–151, 2 refs. Asmara, 1946. (With a Summary in English.)

An account is given of an outbreak of fever that occurred in 1941–42 among workers in the Research Institute at Addis Ababa, Abyssinia, on whom were fed the lice [*Pediculus humanus humanus*, L.] that were being reared for the preparation of anti-typhus vaccine. In all, two Italians and five Abyssinians were affected. The circumstances of the outbreak and the symptoms, which are described, closely resembled those of the similar outbreak in Poland [*R.A.E.*, B **31** 45, etc.], of which the causal agent was described as *Rickettsia*

weigli [**25** 76]. An extracellular rickettsia was isolated from the blood of some of the patients and appeared to be identical with *R. pediculi*. It was non-pathogenic to lice and apparently to most laboratory animals and conferred no immunity from typhus in animals. It is concluded that this rickettsia is identical with *R. pediculi*, that *R. weigli* was insufficiently distinguished from *R. pediculi* and that the disease that occurred in Poland and Abyssinia is the same as trench fever [*cf.* **31** 45], of which the causal organism has been named *R. quintana* (*wolhynica*). *R. weigli*, *R. quintana* and *R. pediculi*, which apparently becomes pathogenic under certain as yet unknown conditions [*cf.* **23** 258], are thought to be identical.

ROUBAUD (E.). **Influence du développement plasmodien sur la fécondité des moustiques hôtes.**—*Bull. Soc. Path. exot.* **38** no. 9–10 pp. 300–304, 2 refs. Paris, 1945.

Arthropods usually remain apparently unaffected by the infectious agents that they transmit. The author believes that this is often because the effects are such that they escape superficial examination, and he describes experiments made in 1942 with females of the biotype of *Culex pipiens*, L., designated *C. autogenicus sternopallidus*, Roub. [*cf. R.A.E.*, B **35** 119] and a strain of *Plasmodium praecox* (*relictum*), the results of which he regards as an indication that heavy stomach infections considerably reduce egg production. On 24th November, 28 females that had laid one batch of eggs before having a blood-meal fed on an infective canary, and 14 examined after six days showed heavy stomach infections. The others oviposited eight days or more after the infective meal. Four laid batches of less than 100 eggs, seven laid batches of 103–148 eggs and three laid batches of 153–181, the average number of eggs per female being 109·3. The females transmitted infection to a fresh canary on 8th December. Seven were then killed and examined for sporozoites and the others oviposited again six days later, laying batches of 126–190 eggs with an average of 157·5. Fourteen control females that had also oviposited once autogenously laid an average of 126·2 eggs each, 4–8 days after making their first meal on an uninfected canary. Only three oviposited after feeding a second time, and these laid an average of 44 eggs each, five or six days after the meal. The author concludes that it is normal for more eggs to be laid in the first than in later batches and that oöcyst infection therefore retarded oviposition and also reduced the numbers of eggs laid in the first batch after the infecting feed by at least a third.

DAO VAN TY. **Sur la biologie d'*Armigeres obturbans* (Walker).**—*Bull. Soc. Path. exot.* **38** no. 9–10 pp. 304–309, 1 fig. Paris, 1945.

A strain of *Armigeres obturbans*, Wlk., was reared in Paris in 1939 from eggs sent from Indo-China on wet filter paper and received when 11 days old. The eggs are not very resistant to drying, compared with those of *Aëdes aegypti*, L., and a very high relative humidity is necessary for them to survive for a month out of water [*cf. R.A.E.*, B **28** 244]. Hatching, which was almost complete within an hour of immersion, is described. Larvae reared in water containing powdered dog biscuit and also the adults that developed from them were under-sized, but larvae reared in water containing cat faeces developed rapidly, grew very large and gave rise to big adults. In China and Indo-China, enormous numbers develop in latrines [*cf.* **18** 15; **25** 26], but larvae are found also in domestic water containers, bamboo stems, tree holes [**31** 239], hoof prints and ditches. The larval and pupal stages lasted ten and three days, respectively, at 20° C. [68° F.]. Adults paired 2–3 days after emergence in a cage measuring 16×16×24 ins. Pairing, which took place only in the air and at night, and

oviposition, which occurred in the evening, are described. The females bit at any hour of the day or night, feeding indiscriminately on man, guineapig or fowl, and a batch of 80–150 eggs was laid four days later. One isolated female oviposited three times after several blood-meals, the number of eggs decreasing in the later batches. No male was observed to live for more than a month, but females survived for six weeks at 20–25°C. [68–77°F.] in a saturated atmosphere, with a supply of sugar solution and blood-meals twice a week. More than 20 generations were reared between January 1939 and June 1940. In a special test, females of the second generation, reared from larvae fed on human faeces, and given sugar solution but no blood-meal, died after 20 days without ovipositing.

Floch (H.) & Abonnenc (E.). **Les moustiques de la Guadeloupe. Genre** *Anopheles.—Publ. Inst. Pasteur Guyane* no. 108, 16 pp., 4 figs., 1 map, 11 refs. Cayenne, 1945. **Les moustiques de la Guadeloupe (II). Les genres** *Megarhinus, Aëdes, Culex, Deinocerites, Mansonia* **et** *Wyeomyia.—Op. cit.* no. 110, 48 pp., 21 figs., 1 map, 8 refs.

In the first paper, notes are given on the geographical distribution, habits and importance as malaria vectors of *Anopheles albimanus*, Wied., *A. aquasalis*, Curry (*tarsimaculatus*, auct.), and *A. argyritarsis*, R.-D., the three species of *Anopheles* f und in Guadeloupe during a collecting expedition in 1944–45 and previously recorded there in 1936 [*R.A.E.*, B **27** 34]. Keys to the larvae, females and male genitalia and a map and tables showing the localities in which each species was taken are included. Adults of *A. albimanus* were taken only once, but larvae were widespread in overgrown pools and ditches, flooded savannah and salt-water marshes, usually in the sun. The larvae of *A. argyritarsis* were found in sugar-cane fields, overgrown ditches and swamps near the coast and in streams and occasionally in Bromeliads at higher altitudes. Only one adult was taken, in the forest. The characters of the egg, larva and adult of *A. aquasalis* as found in Guadeloupe are given, and the different egg forms described by various authors for this and allied species are discussed. The authors agree that *A. emilianus*, Komp, is a synonym of *A. aquasalis* [*cf.* **36** 3]. In Guadeloupe, the immature stages occur in grassy pools, overgrown irrigation channels, flooded savannah and rock pools, usually in brackish water. Adults were taken in great numbers in houses in the evening. This is the only species thought to be of considerable importance as a vector of malaria in Guadeloupe.

The second paper contains notes on the morphology and habits of the 19 mosquitos of Guadeloupe other than *Anopheles*. All except two of those previously recorded there were taken during the expedition, and also nine others, including *Wyeomyia antillarum*, sp. n., which is described. The local distribution of the various species is shown on a map and in tables, and keys are given to the larvae, females and male genitalia of the mosquitos of Guadeloupe including *Anopheles*.

Floch (H.) & de Lajudie (P.). **Recherches sur la trypanosomiase humaine américaine en Guyane française. *Rhodnius prolixus* et *Rhodnius pictipes* vecteurs naturels de choix de** *S. cruzi.—Publ. Inst. Pasteur Guyane* no. 117, 5 pp., 8 refs. Cayenne, 1945.

Three of the six species of Triatomines that have been taken in French Guiana, *Triatoma rubrofasciata*, Deg., *Rhodnius prolixus*, Stål, and *R. pictipes*, Stål, have been found naturally infected with trypanosomes there [*cf. R.A.E.*, B **34** 55]. About 35 of some 100 individuals of *T. rubrofasciata* taken at Cayenne were infected with a trypanosome, the metacyclic forms of which were similar to those of *Trypanosoma* (*Schizotrypanum*) *cruzi*, but which did not develop in

laboratory animals. The strain isolated from the single female of *R. prolixus* taken in 1941 and three strains from *R. pictipes* developed in laboratory animals and were morphologically typical of *T. cruzi*. The measurements for the four strains are given. The fact that infective forms of *T. cruzi* appear in the dejecta of laboratory-infected individuals of *R. prolixus* and *R. pictipes* in three weeks but require two months in *Triatoma rubrofasciata* is thought to indicate that the trypanosome, in French Guiana at least, is better adapted to the first two and that these are therefore the main local vectors. This view was supported by xenodiagnostic tests, in which 85, 90, and 31 per cent. of *R. prolixus*, *R. pictipes* and *T. rubrofasciata*, respectively, acquired infection.

Floch (H.) & Abonnenc (E.). **Ixodidés de la Guadeloupe. Présence de *Dermacentor nitens* Neumann, 1897.**—*Publ. Inst. Pasteur Guyane* no. 118, 6 pp., 1 fig., 6 refs. Cayenne, 1945.

The 9,377 ticks taken during a collecting expedition in Guadeloupe included 30 individuals of *Dermacentor* (*Otocentor*) *nitens*, Neum., from horses, in addition to the three species recorded from the island by Senevet [*R.A.E.*, B **27** 35]. Brief notes are given on the distribution, hosts and importance of the four species and descriptions of *D. nitens* and *Amblyomma variegatum*, F., which was the commonest.

Floch (H.) & Abonnenc (E.). **Sur la validité des espèces *A. ininii* et *A. sancti-elii* Senevet et Abonnenc, 1938.**—*Publ. Inst. Pasteur Guyane* no. 124, 4 pp., 1 fig., 4 refs. Cayenne, 1946.

Adults reared from Anopheline larvae collected in October 1945 and February 1946 in French Guiana included seven individuals of *Anopheles ininii*, Senevet & Abonnenc, and examination of these confirmed the validity of the species, which had been questioned in a monograph already noticed [*R.A.E.*, B **32** 102]. A supplementary description of the male hypopygium and distinguishing characters for the larva and pupa are given [*cf.* **27** 210–211]. The female, which was recognised by identification in the larval and pupal stages, cannot be distinguished from that of *A. oswaldoi*, Peryassú. A male reared from the material collected was thought to belong to either *A. sancti-elii*, Senevet & Abonnenc, or an undescribed species. Characters distinguishing it from *A. ininii* and *A. oswaldoi* are given.

[Kozhanchikov (I. V.).] **Кожанчиков (И. В.). Nutritional Value of Proteins in the Growth of Blow-fly Larvae.** [*In Russian.*] –*Rev. Ent. URSS* **28** no. 3–4 pp. 57–63, 21 refs. Moscow, 1947. (With a Summary in English.)

The following is based on the author's summary: In laboratory experiments on the value of different proteins in the nutrition of larvae of *Calliphora erythrocephala*, Mg., the larvae showed a high degree of specificity for the proteins of the higher vertebrates, especially mammals. Feeding on the proteins of birds (goose) retarded development, and feeding on those of amphibia and fishes caused retardation and also high mortality. Pure proteins (egg albumen), peptones and amino acids alone were not sufficient for normal growth. The larvae proved to be typically saprophagous, showed pronounced bactericidal properties in the digestive tract, were highly adaptable to the pH of the medium, and had a low thermal optimum (about 18–20°C. [64·4–68°F.]). They are killed by the body temperature of the higher mammals and thus cannot develop in the living tissues of mammals or birds.

[Glagoleva (E. M.).] **Глаголева (Е. М.). Ecological Studies on *Anopheles* Larvae in Tadzhikistan, Middle Asia. 3. Breeding Places of *Anopheles hyrcanus* Pall. and their chemical Factors.** [*In Russian.*]—*Rev. Ent. URSS* **29** no. 1–2 pp. 109–118, 4 refs. Leningrad, 1947. (With a Summary in English.)

Anopheles hyrcanus, Pall., is widely distributed and common in the lowlands in Central Asia. In Tadzhikistan, it is abundant in low-lying places in the valleys of the rivers Vakhsh, Kzuil-su and Ak-su and in the valleys of the Hissar mountains, its favourite breeding places being rice-fields and swamps fed by seepage from subsoil water lying close to the surface, in which the water is slow moving, heated by the sun and overgrown with floating and emergent vegetation and dense growths of reeds [*cf. R.A.E.*, B **32** 171].

A study of the chemical composition of the water in typical breeding places was carried out in 1938–40 in rice-fields on four collective farms in three districts, and a detailed account is given of the results. They showed that it was characterised by a low content of minerals (190–250 parts per million dry residue), a low degree of hardness, a fairly high oxygen content (4·15–25·16 p.p.m.), a pH of 7–7·4, and a high temperature (30°C. [86°F.]), all typical of high-level subsoil water.

Larvae of *A. hyrcanus*, unlike those of other species of *Anopheles*, tolerate considerable quantities of both mineral and organic nitrogen and were not affected by about 4·24 p.p.m. nitrates in the water. In tests of various methods of reducing the mosquito population in rice-fields, the introduction of organic fertilisers killed the larvae of all the species of *Anopheles* present except those of *A. hyrcanus*.

Papers noticed by Title only.

[Fedorov (V. G.).] **Федоров (В. Г.). On the larval Morphology of *Aëdes cyprius* Ludl., *A. cinereus* Mg. and *A. leucomelas* Mg. (Diptera, Culicidae).** [*In Russian.*]—*Rev. Ent. URSS* **29** no. 1–2 pp. 103–108, 3 figs., 1 ref. Leningrad, 1947. (With a Summary in English.)

Floch (H.) & Abonnenc (E.). **Description d'une nouvelle espèce d'anophèle : *A*[*nopheles*] (*Stethomyia*) *canorii*** [from a male collected in French Guiana]. —*Publ. Inst. Pasteur Guyane* no. 116, 3 pp., 1 fig. Cayenne, 1945.

Causey (O. R.) & Damasceno (R. G.). **Estudo sôbre *Flebotomus* no vale Amazônico. Parte II. Descrição de *F. dunhami*, *F. melloi* e *F. wagleyi* (Diptera, Psychodidae).** [A Study of *Phlebotomus* in the Valley of the Amazon. Part II. Description of *P. dunhami*, *P. melloi* and *P. wagleyi*, spp. n.]—*Mem. Inst. Osw. Cruz* **42** fasc. 1 pp. 17–29, 22 figs., 3 refs. Rio de Janeiro, 1945. [*Cf. R.A.E.*, B **35** 136.]

Vargas (L.), Martínez Palacios (A.) & Díaz Nájera (A.). **Simúlidos de México. Datos sobre sistemática y morfología. Descripción de nuevos subgéneros y especies.** [The Simuliids of Mexico. Systematic and morphological Data and Descriptions of new Subgenera and Species.]—*Rev. Inst. Salub. Enferm. trop.* **7** no. 3 pp. [6+] 101–192 [+2], 25 pls., 16 refs. Mexico, D.F., 1946. (With a Summary in English.)

Shahan (M. S.) & Giltner (L. T.). **A Review** [from the literature] **of the Epizootiology of Equine Encephalomyelitis in the United States.**—*J. Amer. vet. med. Ass.* **107** no. 824 pp. 279–288, 2 figs., 71 refs. Chicago, Ill., 1945.

SHERRARD (G. C.). **A Report of Damage to Fabric by liquid Hydrocyanic Acid Gas in Fumigation.**—*Publ. Hlth Rep.* **60** no. 44 pp. 1308–1309, 1 pl. Washington, D.C., 1945.

The liquid hydrogen cyanide in a discoid for house fumigation having been found to damage a piece of rayon fabric by softening the fibres and causing them to merge with one another, the action of a very high atmospheric concentration of the gas was investigated. An undamaged piece of the fabric was exposed in an airtight container to 66·6 oz. HCN per 1,000 cu. ft. for 4 hours at 50°F. and a relative humidity exceeding 90 per cent. without any evident injury being caused. The author had shown several years previously that hydrogen-cyanide discoids damaged linoleum through two layers of heavy brown paper but not through four layers. Experience in the fumigation of ships has shown that hydrocyanic acid gas is harmless to fabrics at concentrations not exceeding 6 oz. per 1,000 cu. ft., but direct contact with discoids may cause damage. Fibres of animal or vegetable origin appear to be less susceptible than synthetic ones. In higher concentrations, some fabrics change colour slightly, linen being apparently more susceptible in this respect than cotton or animal fibres.

GAUD (J.). **Présence au Maroc d'*Anopheles* (*Myzomyia*) *turkhudi*, Liston 1901.**—*Arch. Inst. Pasteur Maroc* **3** pt. 4 pp. 144–147, 1 fig. [Casablanca] 1945.

Characters are given distinguishing *Anopheles turkhudi*, List., which was taken in some numbers near Marrakech in 1944, from *A. hispaniola*, Theo., and *A. multicolor*, Camb., the only species of the *Paramyzomyia* group previously known to occur in Morocco [*R.A.E.*, B **26** 121 ; **27** 117]. The chief difference is in the egg and egg mass. Those of *A. turkhudi* are described. In the laboratory at 20–24°C. [68–75·2°F.], the incubation period was four days. Larvae were reared on powdered lichen. They tended to remain at the bottom of the receptacle, where they fed most actively. When at the surface, they normally adopted the horizontal position characteristic of Anophelines but sometimes held themselves vertically.

KNOWLTON (G. F.) & SORENSON (C. J.). **Control Cattle Grubs (Heel and Bomb Flies).**—[*Publ.*] *Utah agric. Coll. Ext. Serv.* N.S. 142, [4] pp., 2 figs. [Logan] Utah, 1946.

A brief account is given of the life-history of cattle grubs [*Hypoderma*] and the harm they cause to cattle. In 1945, the larvae appeared in the backs of cattle during January and February at Logan, Utah, and the mature larvae emerged from 11th April to 29th May ; flies annoyed cattle in central and northern Utah from May to August, appearing later in higher and cooler valleys than in warmer parts. The suggested control measure is the use of rotenone in a dip or a power spray with a pressure of at least 400 lb. where large numbers of cattle are to be dealt with or in a dust or wash where animals are few or treatment has to be begun during cold weather. The first application should be made before the first larvae fall and a second and if necessary a third at intervals of 30 days. Recommended formulae are 1 lb. ground cubé or derris and 2 lb. double-ground cream tripoli earth, volcanic ash (micronised) or pyrophyllite for the dust [*cf. R.A.E.*, B **34** 97], 7·5 lb. cubé or derris in 100 U.S. gals. water for the spray, 12 oz. ground cubé or derris, 4 oz. granular laundry soap and 1 U.S. gal. warm water for the wash [**30** 11], and 10 lb. ground cubé or derris and 2 oz. sodium lauryl sulphate in 100 U.S. gals. water for the dip. The cubé or derris should contain 5 per cent. rotenone. The dust is applied at 3 oz. per animal and thoroughly rubbed into the hair, the spray is used at 100 U.S. gals. per 125–200 cattle, and the wash is scrubbed in at not less than 1 U.S. pint per animal.

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[Nabokov (V. A.) & Nikiforova (A. V.).] **Набоков (В. А.) и Никифорова (А. В.). The Application of DDT Preparations in Mosquito Control.** [*In Russian.*]—*Med. Parasitol.* **16** no. 1 pp. 10–16, 4 figs., 1 ref. Moscow, 1947.

Experiments in which DDT was applied to the walls, ceilings and contents of buildings to form a deposit toxic to Anophelines were carried out in the spring and summer of 1946 in a group of villages in a peat-bog district in the Province of Moscow. Cow-sheds were dusted with 10 per cent. DDT or sprayed with a suspension of the dust in water at the rate of 1 gm. DDT per sq. metre and workmen's quarters and the furniture in them were sprayed with an emulsified solution at 0·3 gm. per sq. metre. One application in spring almost completely freed the cow-sheds from Anophelines for the four months of the malaria season, whereas in control sheds their numbers steadily increased, reaching a maximum by the end of June. In workmen's quarters, the Anopheline population was reduced by a single treatment in June to 14 per cent. of that in the control huts for the rest of the season. The best results were obtained in villages in which both living quarters and cow-sheds were treated.

Observations to ascertain whether the effect was due to repellence showed that as many Anophelines entered treated premises as untreated ones. They readily alighted on treated surfaces, but such surfaces were quite free from mosquitos 2–3 hours later. When 400 Anophelines were released in a treated cow-shed with muslin on the floor, practically all of them were found paralysed on the muslin three hours later. The insecticidal action ceased and the premises became reinfested when the deposit was mechanically removed from the treated surface.

Treatment of the living quarters alone did not reduce the numbers of larvae in neighbouring sections of the peat-bog, but treatment of the cow-sheds reduced them considerably, and treatment of both was still more effective, the numbers of larvae per unit of water surface being only 5 per cent. of those near an untreated village.

Examination of about 2,000 females by Detinova's method [*R.A.E.*, B **34** 180] showed that the proportion of newly emerged females that had not yet oviposited was about twice as great in treated villages as in untreated ones, the likelihood of malaria transmission being correspondingly reduced.

[Derbeneva-Ukhova (V. P.).] **Дербенева-Ухова (В. П.). The Application of DDT Preparations against Flies.** [*In Russian.*]—*Med. Parasitol.* **16** no. 1 pp. 16–28, 10 figs., 5 refs. Moscow, 1947.

The experiments described were carried out in 1946 in villages and parts of a town in the Province of Moscow to observe the effect of treatment with DDT on the population of flies [chiefly *Musca domestica*, L.] in buildings. Dusts, suspensions and emulsified solutions were used. In the village in which the best results were obtained a suspension was applied, at the rate of 0·3 gm. DDT per sq. metre of surface, to practically all the workmen's huts in the second week of June and to all the shops and a restaurant on 9th July, before the usual increase in the population of flies had occurred. At the end of July the numbers taken were only 10·2 per cent. of those taken in an untreated village, in which they had then reached their maximum. The toxic action of the deposit continued for the rest of the season. In another village, in which animal quarters were dusted on the 16th–20th May at the rate of 1 gm. DDT per sq. metre, the numbers of flies in houses were 71·8 per cent. less than in the control village at the end of July, but they subsequently increased, probably owing to emergence from untreated refuse bins. In a third village, animal quarters were dusted

on 10th May, at the rate of 1 gm. DDT per sq. metre, workmen's huts with an emulsified solution sprayed on 28th–30th May and restaurants and food shops sprayed with a suspension on 5th July, the respective rates of application being 1, 0·175 and 0·3 gm. DDT per sq. metre. As a result, the fly population did not increase steadily throughout the season as it usually did, and though there were three peaks of abundance, in July, August and September, each was followed by a drop that brought the numbers to their initial level. These peaks were probably due to the low dosage applied in living quarters, which delayed mortality. In the fourth village, the restaurant, food shop and bakery, which attracted great numbers of flies from considerable distances, were sprayed with a suspension on 5th July at the rate of 0·3 gm. DDT per sq. metre. Here again the numbers of flies in houses showed three moderate peaks during the season, each followed by a fairly sharp drop to the initial level, probably because the flies migrated from the houses to the premises connected with food, where they came into contact with the treated surfaces and were killed.

In the town, restaurants, food shops, hospitals and children's institutions were sprayed in late June with DDT suspensions and emulsions, the dosage varying from 0·06 to 0·3 gm. DDT per sq. metre except in two premises in which it was 0·84 gm. Though the immediate reduction in the numbers of flies was about 92–98 per cent., they were still considerable and increased progressively after 2–4 weeks. The failure to prevent this increase is attributed to the slow action of the low dosages used, and to the hot weather, which increased the activity of the flies, so that they seldom settled on the treated surfaces by day, and which probably caused a reduction in the toxicity of the DDT deposits. A reduction in the effectiveness of DDT deposits at high temperatures was confirmed by experiments in which strips of filter paper that had been rubbed on the treated walls of kitchens with a temperature of 36°C. [96·8°F.] caused less rapid paralysis of flies than did strips rubbed on the walls of rooms with a temperature of 25°C. [77°F.]. The same premises were sprayed again in late July or early August at a rate of 0·17–1·75 gm. DDT per sq. metre, and the numbers of flies present a month later were in most cases 90 per cent. less than in the control buildings.

A test was also made of the treatment of the breeding places to kill the newly emerged adults, which cannot fly within 1½–2½ hours of emergence, and the mature ones that come to oviposit. The walls and lids of refuse boxes, cess-pits and latrines, and the ground round them were treated four times at intervals of three weeks beginning on 12th June, but the intervals could be prolonged, since flies that came into contact with an unpainted wooden partition treated some 10 weeks previously became paralysed. Spraying proved troublesome and was abandoned in favour of dusting by hand from small muslin bags which gave the high rate of 2·24–2·8 gm. DDT per sq. metre. The numbers of flies in houses in the vicinity was lower than in other parts of the town a month after treatment began, and the peak population at the end of July was less than twice as great as in early June, whereas it was nine and 20 times as great in two control sections. Treatment of the soil round open heaps of refuse was found to be ineffective.

[Nabokov (V. A.) & Potikha (B. S.).] **Набоков (В. А.) и Потиха (Б. С.). An Experiment on the Use of DDT Preparations against Bed-bugs.** [*In Russian.*]—*Med. Parasitol.* **16** no. 1 pp. 28–30. Moscow, 1947.

In the summer of 1946, 1–5 per cent. emulsions of a concentrate containing 35 per cent. DDT were applied at a rate of 100 ml. per sq. metre to the interior, including the furniture, of huts and other buildings heavily infested by *Cimex lectularius*, L., in a village and a town in the Province of Moscow. All the con-

centrations proved very effective, and not only freed the treated premises from bed-bugs for the three months during which the observations were continued, but also gave good control of the cockroaches, *Blattella* (*Blatta*) *germanica*, L., and *B.* (*Periplaneta*) *orientalis*, L.

[Pospelova-Shtrom (M. V.).] **Поспелова-Штром (М. В.). The Action of a DDT Preparation on the Tick** *Alectorobius verrucosus* **(Ol., Zass. & Fen.), 1934.** [*In Russian.*]—*Med. Parasitol.* **16** no. 1 pp. 30–33. Moscow, 1947.

Laboratory experiments were carried out in 1944 on the effect on *Ornithodoros* (*Alectorobius*) *verrucosus*, Olen., Zas. & Fen., of DDT of Soviet manufacture, which is called pentachlorin. In a test at 20–23°C. [68–73·4°F.], a nymph and an adult female that were left for two hours in a wide test-tube containing several small portions of the DDT and subsequently kept at 18°C. [64·4°F.] showed symptoms of paralysis on the third and fourth day, respectively, and died in 10 and 12 days. When three drops of a saturated solution of the DDT in liquid paraffin were applied with a fine brush at 40–45°C. [104–113°F.] to the dorsal or ventral surface of the last abdominal segment, and prevented from approaching the spiracles, a hungry nymph treated on the ventral surface died in five days, and a hungry and an engorged nymph treated on the dorsum in two and three weeks, respectively.

In the final experiment, the DDT was applied over one half of the closely clipped surface of the abdomen of a guineapig, and a male and a female, both unfed, were placed on it. As a control, another female from the same lot was placed on the untreated half of the abdomen. All three ticks engorged rapidly and dropped from the host ; they became paralysed in 3, 7 and 4 days, respectively, and died 10, 30 and 24 days after the beginning of the experiment. It is thought that the control female became affected by DDT through being touched once with the forceps immediately after they had been used to move the engorged male.

[Okulov (V.).] **Окулов (В.). The Results of Tests of the new Soviet Insecticide, Pentachlorin Paste.** [*In Russian.*]—*Med. Parasitol.* **16** no. 1 pp. 33–35. Moscow, 1947.

In the experiments described, which were carried out in the Crimea in 1945, a 10 per cent. emulsion of pentachlorin paste, a concentrate of Soviet manufacture stated to contain 40 per cent. DDT, was sprayed at a rate of 10 ml. per sq. metre on to various surfaces, and insects were subsequently confined on them for definite periods. Periods of contact with a freshly dried surface that gave complete mortality and (in brackets) those that elapsed before the insects died were 5 minutes (5–8 hours) for sandflies [*Phlebotomus*], 5 minutes (18–20 hours) for flies [*Musca domestica*, L.], 20 minutes (3·7 hours) for mosquitos, and 10 minutes (40–48 hours) for bed-bugs [*Cimex lectularius*, L.]. Longer periods of contact accelerated mortality in all cases, and most mosquitos died after contact for only 5 minutes. The periods of exposure necessary for complete mortality were longer when the insects were exposed some time after the surfaces had been treated, 10–14 and 167 minutes being required for sandflies after 10–15 and 20 days, respectively, 380 minutes for flies after 27 days, 55 minutes for mosquitos after 45 days, and 25 minutes for bed-bugs after 7 days.

It is concluded that the spray would be effective against all these insects in practice, since they normally remain long enough on surfaces for the deposit to take effect.

[Vashkov (V. I.) & Sazonova (N. A.).] **Вашков (В. И.) и Сазонова (Н. А.). Some Data on the toxic Features of Dichlordiphenyltrichlorethane (DDT).** [*In Russian.*]—*Med. Parasitol.* **16** no. 1 pp. 36–38. Moscow, 1947.

In all but one of these experiments, the DDT was tested as a suspension in dilute starch paste and as a solution in apricot oil. Ingestion of the suspension caused 3·5 and 83 per cent. mortality of mice when the dosages were 0·5 and 1·2–1·3 mg. DDT per gm. body weight, respectively. Ingestion of the solution caused 5, 50 and 100 per cent. mortality of mice at 0·1, 0·2 and 0·5 mg. per gm., produced symptoms of poisoning in rabbits at 0·1 gm. per kg., and killed all rabbits that received over 0·3 gm. per kg. and three of five guineapigs that received 1 gm. per kg. A cat given 50 gm. pure DDT per kg. body weight in its food 9 times in the course of 15 days died three days later.

When injected subcutaneously, the suspension caused 15 and 45 per cent. mortality of mice within 12 days at doses of 3 and 4 mg. DDT, respectively, per gm. body weight, and the solution caused 10 and 100 per cent. at doses of 0·4 and 0·9 mg. per gm.

[Vashkov (V. I.) & Serebryakova (E. K.).] **Вашков (В. И.) и Серебрякова (Е. К.). Some Data on the toxic Features of Hexachlorcyclohexane.** [*In Russian.*]—*Med. Parasitol.* **16** no. 1 pp. 41–43. Moscow, 1947.

In experiments similar to those with DDT [*cf.* preceding abstract], ingestion of a solution of benzene hexachloride in apricot oil at doses of 0·075 0·1, 0·4–0·5 and 1 mg. per gm. body weight caused 6–10, 52 and 100 per cent. mortality of mice, respectively, and ingestion of a suspension in dilute starch paste at doses of 0·5, 0·8 0·9, 1·25–1·5 and 2 mg. per gm. caused 15, 35–70, 70-90 and 100 per cent. When injected subcutaneously, doses of 0·2, 0·7–0·8 and 1 mg. benzene hexachloride per gm. in the solution gave 6, 50 and 90 per cent. mortality, and doses of 0·5, 0·9–1·5 and 2 mg. in the suspension gave 5, 50 and 65 per cent. Death usually occurred within a week. The toxic dose for guineapigs by oral administration in the solution was 0·5 gm. per kg. body weight. When two rabbits and three guineapigs each received 50 mg. benzene hexachloride per kg. body weight 17 times in 30 days, none was affected and all gained in weight.

[Vashkov (V. I.).] **Вашков (В. И.). Testing the Toxicity of DDT by imposing Bandages impregnated with Solutions and Emulsions of this Preparation.** [*In Russian.*] –*Med. Parasitol.* **16** no. 1 pp. 38–40. Moscow, 1947.

A summary is given of experiments on the potential danger to man of contact with fabrics impregnated or dusted with DDT. The preparations tested were a dust of 5-10 per cent. DDT in talc, emulsified solutions containing 1-5 per cent. DDT, and 2, 3, 5 and 10 per cent. solutions of DDT in several solvents. Bandages were treated with 5–10 gm. of the dust, or impregnated with 5-10 ml. of the liquids, in the latter case being used wet or after drying in the open air for 16 24 hours, and applied to patches 60 sq. cm. in area on the shaven or clipped skin of rabbits. The bandages were used once only and were renewed at intervals of 1, 2 or 3 days for periods that ranged up to 55 days.

Bandages impregnated with solutions of DDT in apricot oil, acetone, turpentine or dichlorethane and applied wet and those impregnated with solutions in kerosene and dried for 24 hours caused severe poisoning in 24-72 hours, and sometimes death. On removal of the bandages, the toxic symptoms ceased

within 48 hours in the less severe cases. Dry bandages impregnated with solutions of DDT in solvents (such as dichlorethane or turpentine) that evaporated completely in the course of drying did not produce any toxic effect. Contact for 50 days with bandages treated with the emulsified solution or for 30 days with the dust had no ill-effects. Control rabbits were not affected by bandages impregnated with kerosene alone and dried.

[Vashkov (V. I.).] **Вашков (В. И.). The Influence of a Bandage impregnated with a Preparation of Hexachlorcyclohexane on the Rabbit's Organism.** [*In Russian.*]—*Med. Parasitol.* **16** no. 1 pp. 43–45. Moscow, 1947.

In experiments similar to those with DDT [*cf.* preceding abstract], the application for up to 180 days of bandages impregnated with 10 ml. of 1, 3, 5 or 10 per cent. solutions of benzene hexachloride in turpentine or dichlorethane and dried in the open air for 16–24 hours had no effect on the rabbits. A 10 per cent. solution in apricot or sunflower-seed oil caused slight poisoning in two days, but the symptoms did not become more acute even after treatment for 20 consecutive days, during which the bandages were renewed six times. All the rabbits recovered two days after the removal of the bandages. A 5 per cent. solution in oil and 5 gm. of a 5 or 10 per cent. dust had no effect in 20 days. A 10 per cent. solution in kerosene caused acute or fatal poisoning in 3 4 days and though 1, 3 and 5 per cent. solutions did not cause death, they apparently had some weakening effect, since a large proportion of the animals died from other causes.

To study the effect of the vapours of benzene hexachloride, caged mice were kept in a glass chamber of about 32 gals. capacity, the walls of which had been treated with a 10 per cent. solution in acetone and allowed to dry. No ill-effects were observed after 15 days' exposure.

Five volunteers who wore underclothes impregnated with 0·5 per cent. benzene hexachloride in dichlorethane for a week suffered no ill effects, and underclothes treated with a dust under practical conditions caused no discomfort to five families.

It is concluded that benzene hexachloride is toxic only if applied in a solvent that does not evaporate quickly.

[Viktorov (V. F.) & Zhenzhurist (Yu. S.).] **Викторов (В. Ф.) и Женжурист (Ю. С.). The Application of Thiodiphenylamine in the Control of *Anopheles* Larvae.** [*In Russian.*]—*Med. Parasitol.* **16** no. 1 p. 46. Moscow, 1947.

In preliminary field experiments in the Province of Saratov in September 1945, phenothiazine (thiodiphenylamine) was tested for the control of Anopheline larvae as a dust and as a suspension in weak soap solutions; the rate of application in all cases was equivalent to 0·9 lb. phenothiazine per acre. The dust was applied from an aeroplane and gave complete mortality of the larvae in ten lots of water covering a total area of over 4½ sq. miles, the temperature of the water being 17–20°C. [62·2–68°F.]. The suspensions contained 1 lb. phenothiazine and 0·3 or 0·5 lb. soap in 30 gals. water. The one containing 0·3 lb. soap killed 74 per cent. of the larvae when applied with a hand-sprayer and 77·3 per cent. when applied with a brush, and the one containing 0·5 lb. killed all the larvae when applied with the hand-sprayer. These results are not considered conclusive, however, and further tests with the suspension are recommended.

[Kalandadze (L. P.) & Kaviladze (O. P.).] **Каландадзе (Л. П.) и Кавиладзе (О. П.). On the blood-sucking Mosquitoes of the western Part of Persian Azerbaijan.** [*In Russian.*]—*Med. Parasitol.* **16** no. 1 pp. 57–65, 5 graphs, 7 refs. Moscow, 1947.

A list is given of 14 species of mosquitos taken in Persian Azerbaijan in 1944 and 1945. The Anophelines comprised *Anopheles maculipennis*, Mg., which was the commonest, *A. superpictus*, Grassi, which was next in abundance, *A. claviger*, Mg. (*bifurcatus*, auct.), which was common in one locality, and *A. algeriensis*, Theo., and *A. plumbeus*, Steph., which were rare. Examination of eggs laid in the laboratory showed that *A. maculipennis* was represented by var. *typicus*, which was widely distributed, and var. *sacharovi*, Favr, which occurred in only five localities.

During the day the Anophelines sheltered in animal quarters and also occurred in houses of the European type, but were uncommon in native dwellings, on account of the smoke from the fires in them. They were attracted to animals in such buildings, but entered only when the fire was not burning. *A. superpictus* entered tents in the evening, when the temperature fell, and attacked the occupants throughout the night.

Larvae of *A. maculipennis* were first observed about the end of April, and males were emerging by mid-May ; the higher temperatures of the summer and autumn indicate that there may be 5–6 more generations during the season. Females began to enter hibernation quarters at the beginning of November. Both *A. maculipennis* and *A. superpictus* overwintered in cold quarters, such as ruined clay buildings, storage premises, or native cellars consisting of pits covered with branches. Measures against the larvae of *A. maculipennis* should be continued from May onwards, but since larvae of *A. superpictus* were not found until the second half of July, breeding places of this species need not be treated until the end of that month. The curve of seasonal abundance of *A. maculipennis* in 1944 showed a peak in May-June, and a smaller peak in September. In the case of *A. superpictus*, a small peak occurred in August.

[Beklemishev (V.) & Shipitzina (N.).] **Беклемишев (В.) и Шипицина (Н.). *Anopheles marteri* in the north-western Iran.** [*In Russian.*]—*Med. Parasitol.* **16** no. 1 pp. 66–67, 3 figs., 9 refs. Moscow, 1947.

The authors review the distribution of *Anopheles marteri*, Sen. & Prun., which is a Mediterranean species, and consider that *A. sogdianus*, Keshish'yan [*cf. R.A.E.*, B **27** 183] is a subspecies of it. A single larva taken in October 1941 in a stream on the road between Kazvin and Resht, in north-western Persia, clearly belonged to *A. marteri* and resembled subsp. *sogdianus* ; characters are given distinguishing it from larvae of *A. lindesayi*, Giles, which occurs in the mountainous regions in the south and east of the Central Asiatic plateau. Other larvae found in the stream were *A. claviger*, Mg. (*bifurcatus*, auct.) and, lower down, *A. superpictus*, Grassi.

Fenaroli (A.). **Solfocianderivati applicati al campo entomologico. Nota I : esteri ciclici dell'acido solfocianacetico.** [Thiocyanic Derivatives for entomological Use. Note I : Cyclic Esters of Thiocyanoacetic Acid.] —*Boll. Zool. agr. Bachic.* **13** fasc. 1, 39 pp., 4 graphs, 24 refs. Milan, 1945.

The author reviews the literature on the use of thiocyanates as insecticides [*cf. R.A.E.*, B **30** 144] and describes experiments carried out in northern Italy in 1944 on the control of Arthropods with thiocyanoacetic esters, chiefly those of cyclohexanol and amyl alcohol [*cf.* also A **36** 252]. Preliminary

tests designed to assess their action as fumigants and stomach poisons gave inconclusive results, but garden spiders of two species that crawled over a thin layer of dusts impregnated with them died within a few minutes. Both esters were tested in a petroleum oil as sprays against *Musca domestica*, L., in cages containing several hundred adults. The lowest satisfactory concentration for either material was found to be 3 per cent.; below this they gave incomplete mortality and required over 30 minutes to take effect. The sprays were also tested against *M. domestica* in cattle sheds and in rooms of various sizes on farms, and it is concluded from graphs on which the speed of action of the compounds is plotted against concentration that the optimum concentration is 7 per cent. for the cyclohexanol compound and 5·5 for the amyl alcohol; a mixture of the two (2 : 1) gave optimum results at 6 per cent., at which it gave complete mortality in five minutes when applied at 0·8 fl. oz. per 1,000 cu. ft. The mixture had a less pungent odour than the amyl-alcohol compound alone. The sprays were also applied in rooms against *Culex pipiens*, L. Concentrations of 4–5 per cent. of either ester gave 12–20 per cent. kill in about 10 minutes and were sufficient for practical purposes, as the surviving mosquitos were stupefied and did not fly or bite for about 10 hours; but to obtain a total kill it was necessary to use 11 per cent. of the amyl-alcohol product or of the mixture, both of which acted in about 5½ minutes, or 12 per cent. of the cyclohexanol product, which acted in just over 4½ minutes.

The thiocyanoacetic esters of phenol and of β-naphthol, as well as the two already employed, all as 10 per cent. dusts adsorbed on bentonite, were tested in a small-scale laboratory experiment in which they were sprinkled, at the rate of 10 mg. on the surface of about 110 cc. water in petri dishes with a diameter of 7 cm. containing a number of aquatic insects, including about 50 larvae of *C. pipiens*, and some water weeds. The first two esters proved ineffective; those of amyl alcohol and cyclohexanol killed 19 and 25 mosquito larvae, respectively, in 40 hours, in which period six died in an untreated control.

Dusts containing 10 per cent. of the amyl alcohol and cyclohexanol esters on bentonite were tested in the laboratory against cockroaches. Examples of *Blatta orientalis*, L., placed in petri dishes with a thin layer of powder on the bottom, died within 15 minutes. Batches of ten cockroaches were then introduced into large glass vessels with filter paper on the bottom, and with food and shavings on one side and a narrow band of dust on the other. The cockroaches were placed close to the food and did not appear to be either attracted or repelled by the dusts, but in the course of 12 hours all came into contact with them and died; there was no mortality in the controls. In subsequent tests in infested kitchens and cellars, the dusts were spread round the edges of the floor and in the crevices at the foot of the walls. Numerous dead cockroaches were found each morning on or near the insecticides, and after 4 5 days the premises were completely free of infestation. There was no appreciable difference in effectiveness between the two dusts.

They were also equally effective when applied to chickens heavily infested by *Dermanyssus gallinae*, Deg. Groups of 20 chicks were dusted with the powders in the evening: the mites immediately fell from them and died on the ground in a few minutes. The floor of their sleeping quarters was also dusted to prevent reinfestation during the night. In the morning, the treated chicks had good appetites, whereas untreated ones refused to feed. The treatment was extended to all the chicks in the brood, and after three nights all were completely free from mites.

When dogs were treated with the powders, both gave complete control of *Ixodes ricinus*, L., and *Ctenocephalides* (*Ctenocephalus*) *canis*, Curt., without harm to the dogs. The dusts were applied by hand or with bellows, 10–15 gm. per animal, the dose being usually spread over 2–3 applications, to avoid

excessive waste through the animal shaking it off. The fleas fell off and died without further movement in 2–3 minutes; the ticks detached themselves at the first contact and died about 15 minutes later.

The methods of preparing the β-naphthol, phenol and cyclohexanol esters are described.

THEODOR (O.). **Classification of the Old World Species of the Subfamily Phlebotominae (Diptera, Psychodidae).**—*Bull. ent. Res.* **39** pt. 1 pp. 85–115, 2 pls., 15 figs., 34 refs. London, 1948.

Earlier attempts to classify the PHLEBOTOMINAE are reviewed, and the relative importance of the various characters used is discussed. As a result of a study of the original descriptions of nearly all the 127 Old World species and of specimens of about 100 species and varieties, a fresh provisional classification is proposed. It involves the recognition of four genera, *Phlebotomus* and *Sergentomyia* (of which *Prophlebotomus* is a synonym) for the species in the Old World, and *Lutzomyia* and *Brumptomyia* for the American species. The respective genotypes are *papatasi*, Scop., *minuta*, Rond., *longipalpis*, Lutz & Neiva, and *brumpti*, Larrousse. The genus *Phlebotomus* contains nearly all the species that feed on man and other mammals in the Old World and all those that are implicated in the transmission of disease there. The species comprising it have either no trace of teeth in the buccal cavity or only a few isolated small teeth, which never form a definite armature, whereas the species of *Sergentomyia* have a well-developed buccal armature. Most of the American species that have been fully described have a buccal armature of a certain type, which differs from that of the Old World species, and these are placed in the genus *Lutzomyia*. American species without a buccal armature are tentatively put in the genus *Brumptomyia*, but further study may show that it is possible to refer them to the genus *Phlebotomus*.

The characters are given of the family PSYCHODIDAE, its four sub-families, the four genera of PHLEBOTOMINAE, nine subgenera of *Phlebotomus*, of which six are new, three subgenera of *Sergentomyia*, of which one is new, and various groups and sections of groups of the typical subgenus of *Sergentomyia*. A key is included to the Old World subgenera of PHLEBOTOMINAE, and also a list of the Old World species, showing synonyms and distribution. In the genus *Phlebotomus*, as here restricted, *perniciosus* var. *nitzulescui*, Simič, is considered a synonym of *larroussei*, Langeron & Nitzulescu, and *sergenti* var. *mongolensis*, Sinton, is raised to specific rank. In the genus *Sergentomyia*, *mathisi*, Parr. is considered a synonym of *buxtoni*, Thdr., *schwetzi* var. *aethiopicus*, Parr., of *schwetzi*, Adl., Thdr. & Parr., *chalami*, Young & Chalam, of *zeylanica*, Annan., *iraqi*, Adl. & Thdr., of *squamipleuris*, Newst., and *matadiensis*, Theo., of *wansoni*, Parr., and *freetownensis*, Sinton, is considered a variety of *africana*, Newst.

LEWIS (D. J.). **The Mosquitos of the Jebel Auliya Reservoir on the White Nile.**—*Bull. ent. Res.* **39** pt. 1 pp. 133–157, 1 pl., 3 figs., 1 map, 30 refs. London, 1948.

The mosquito fauna in the area of the Jebel Auliya Reservoir, which extends some 330 miles up the White Nile from the Jebel Auliya Dam, about 25 miles south of Khatoum, was surveyed several times between 1937 and 1946, principally with a view to controlling vectors of malaria, which occurs throughout the area and appears to have increased since the dam was built. General mosquito control is, however, considered desirable, as yellow fever occurs in areas from which steamers travel northward through the reservoir to meet

trains in which infected individuals might be carried to other parts of the country [*cf. R.A.E.*, B **35** 105], and there are also species that are a nuisance to man and animals. The topography, climate and population of the area, which is considered in three sections, and the reservoir and its vegetation are described. Construction of the reservoir has increased mosquito production in the southern section, but this is because it has lengthened the breeding season and extended the breeding area rather than changed its character, as a flood plain existed previously. In the more northern sections, reservoir conditions have formed extensive grass and sedge swamps, filled small watercourses, and increased the effect of waves in building sand bars. They have brought to an end papyrus-protected swamps in the central section.

A list is given of the 43 species and varieties of mosquitos found in the area. Details of the association of larvae with different types of breeding-places and the conditions under which adults were taken are shown in tables, and the habits of the Anophelines and their relation to malaria are discussed. It is concluded that the principal vectors are *Anopheles gambiae*, Giles, probably the main one, and *A. rufipes*, Gough. The latter is common in houses, but is nevertheless much less endophilous than *A. gambiae* and often barely outnumbers it, although larvae of *A. gambiae* are found only near the shore, especially in disturbed vegetation, whereas *A. rufipes* breeds profusely over vast areas. It breeds chiefly in sub-surface vegetation and is therefore difficult to control. *A. pharoensis*, Theo., is very common near its breeding places in the swamps, but although it bites man readily and was taken in houses, circumstantial evidence suggests that it is not an important vector of malaria in the region.

The scarcity of larvae in certain large areas of swamp where plants do not grow compactly is probably due to the action of predacious insects and of fish, of which there are several indigenous species in the swamp. Two successful attempts have been made to introduce *Gambusia affinis holbrooki*. In the southern section of extensive swamps and few inhabitants, where *A. funestus*, Giles, occurs, intensive house-spraying appears to be the most feasible method of control in the few villages that exist. In the other sections, the breeding places of *A. gambiae* can be treated with Paris green or with DDT in oil. Pyrethrum spray in houses is used against *A. rufipes*, and parts of the swamps are treated with Paris green dust or DDT in oil. The control of aquatic plants is not practicable. Treading down of the vegetation should be avoided as much as possible. Control of *A. pharoensis* is similar to that of *A. rufipes*. Growth of thick vegetation and the stacking of straw near houses are discouraged to prevent close association between *A. pharoensis* and man. The reasons for the superiority of dusts over sprays for use as larvicides in the White Nile are given, and the Paris green mixer used is briefly described.

ROBERTS (F. H. S.) & O'SULLIVAN (P. J.). **Studies on the Behaviour of adult Australasian Anophelines.**—*Bull. ent. Res.* **39** pt. 1 pp. 159–178, 3 figs., 10 refs. London, 1948.

An account is given of observations on the behaviour of adult Anophelines made in 1944 at Cairns in northern Queensland and at Salamaua and Mirivasi in New Guinea. Atherton & Lemerle had observed at Lalapipi, New Guinea, that *Anopheles farauti*, Lav., rested during the day in sheltered places in the bush near dwellings and appeared to remain in tents and huts only long enough to feed. During an epidemic of benign-tertian malaria (*Plasmodium vivax*) in the Cairns area in 1942, G. A. M. Heydon found sporozoites in 0·66 per cent. of 1,535 females of this Anopheline [*cf. R.A.E.*, B **32** 161] and in one out of 79 females of *A. amictus hilli*, Woodhill & Lee.

At the time of the authors' investigations, many of the swampy areas of Cairns were covered with vegetation and *A. bancrofti*, Giles, was breeding in them, but this species rarely attacks man there and is considered unimportant. *A. farauti* breeds prolifically in the brackish-water swamps of the south-western section of the city and *A. a. hilli* also early in the year. Observations were made on both from January to April. The numbers of females taken between 7.30 and 9.30 p.m. on 11 days between 3rd February and 11th April at a catching station close to occupied houses and about 400 yards from a large brackish swamp in which both mosquitos were breeding plentifully are shown in a table. *A. a. hilli* was prevalent at first, but disappeared after 13th March on account of flooding of the breeding area by rain. *A. farauti* reached a biting rate of 76 per man per hour on 6th March and thereafter decreased, possibly owing to the institution of control measures, but remained fairly prevalent. Both species preferred the lower parts of the body. The first females of both arrived about 7.15 p.m. just as it was getting dark. Numbers of *A. farauti* were fairly constant from 8.30 until 5 with a small peak at 1.30–2.0 a.m. The catch between 5.30 and 6 a.m. was very small. Adults of *A. a. hilli* arrived in waves and showed four distinct peaks of between 8.30 p.m. and 4 a.m. Their numbers fell considerably just before daylight. Both species continued to be active during light showers, but not during heavy rain. Heavy continuous rain had little effect on abundance. Females of both species rest on grass and weeds, and will enter houses to feed. They enter brightly lighted rooms but prefer the more shaded places.

Observations made between 7.30 and 10 a.m. indicated that only a few shelter in houses by day. Those found were in dark corners usually near the floor and behind furniture, and nearly all had recently engorged. A female of *A. farauti* and several males were found in a stack of timber under a house, but the favourite outdoor resting place of both sexes was the trash of banana plants near houses. Careful searching in the surrounding dry bush failed to reveal a single adult. Males were found resting up to 600 yards from the nearest breeding area. Of 211 females examined, 77 had fed on the night before capture, and many others contained traces of earlier blood-meals. Good catches were usually made after rain. On dull mornings, some of the females attempted to bite when disturbed. Only 11 females of *A. a. hilli* were taken in the same habitat. Seven had fed the previous night and three contained traces of blood-meals. Observations on sheltering near the breeding area were confined to a large, shallow, largely sunlit swamp of brackish water (840 parts chloride per 100,000) in which both species were breeding in large numbers. Several males and females of *A. a. hilli* and one unfed female of *A. farauti* were found among the thick grass and litter extending back from the edge of the swamp, and many adults of *A. a. hilli* of both sexes in the swamp itself, often on the shady side of mangrove stumps and reeds in the water, only a few inches above the surface. Only one of 101 females examined showed evidence of a recent blood-meal, but most had traces of old ones.

Throughout, the age of females was estimated and correlated with habitat to give information on bionomics. The criteria used were the condition of the wings and ovaries [**29** 93] and the presence or absence of blood in the midgut and of spermatozoa. It was shown that any attempt to determine age on wing condition alone would be most unreliable. Laboratory observations on *A. punctulatus*, Dön., showed that the ovary reaches stage II within 24 hours, that its development and maturation proceeds in the absence of fertilisation, though only one batch of eggs matures, that its maturation occurs only after a blood-meal and more than one meal is required by many females before most of the follicles mature, and that complete maturation of the follicles after a blood-meal and in summer occurs on the third or fourth days, there being an interval of about one day between each of the stages. It is concluded that

recently emerged mosquitos have stage I wings and stage I or early stage II ovaries, and no blood in the midgut if under 24–36 hours old ; mosquitos with stage V ovaries are at least 4–5 days old ; mosquitos with stage II and sometimes stage III ovaries and with one or more retained mature eggs are at least 5–6 days old ; females with stage III ovaries and no evidence of blood in the midgut have laid at least one batch of eggs and are at least 6 days old ; and females with stage II ovaries, one or more retained mature eggs, and no spermatozoa, have probably laid at least two batches of eggs and are at least 8 days old. A suggested classification of stage II ovaries into three subdivisions (A, B and C), each possibly having some bearing on oviposition, is given on the basis of observations on wild females of *A. farauti* in New Guinea.

The data collected on the ages of the females taken are discussed. Interpretations of the ovary development of females of *A. a. hilli* indicated that most of those near breeding grounds were there for oviposition. Females with stage II follicles had deposited their eggs and those with stage V follicles were about to do so. The large numbers of males observed during the day on the breeding area is a clear indication that fertilisation occurs here.

Of eight females of *A. a. hilli* from occupied dwellings, the blood-meals of which were examined, all had fed on man. Out of 81 females of *A. farauti*, 7, 18, 21, 5 and 30 had fed on man, horse, ruminant, dog and poultry, respectively. Ruminants and poultry were the most easily accessible hosts. Of 88 samples of blood from *A. farauti* taken by Atherton & Lemerle in the bush at Lalapipi, 19, 47, 33 and 1 per cent. were positive for man, dog, pig and cat, respectively. Of 87 samples from *A. punctulatus* collected in outdoor resting places at Milne Bay, 94 per cent. were positive for man.

Observations at Salamaua were made from May to July and at Mirivasi from August to October. At Salamaua, *A. punctulatus* was the only Anopheline bred from two areas in both of which breeding was confined to a series of pools in wheel tracks. Larvae of this species were very numerous also around a hospital and cemetery and a few larvae of *A. farauti* were taken from the edge of an extensive sago-palm swamp and from pools near the hospital. Adults taken in the hospital and cemetery included *A. punctulatus*, *A. farauti* and intermediate forms [*cf.* **35** 174]. Few were taken at night near a breeding area, but large numbers in ill-lit huts close to the ground. Catches of both species and of intermediates increased gradually from evening until midnight, remained high until about 3 a.m. and then declined. They were high on calm, clear nights but fell off considerably with any breeze and lowering of temperature or during heavy rain. The adults arrived in waves lasting 10–15 minutes. Of 728 taken in huts at night, 431 were resting unfed. Resting positions included walls and roof and furniture. Females rested again close to the host after feeding, and flew only a short distance when disturbed. Both engorged and unfed adults were timed to rest for up to 72 minutes. The females were more attracted to natives than to white men. Adults of *A. farauti* were found half a mile from the breeding grounds at Cairns in 1942, but not one mile away, whereas at Salamaua isolated females were not uncommon in huts about a mile from the nearest likely breeding ground. It was concluded from the night catches that the females probably leave the breeding areas shortly after emergence to seek a blood-meal, and congregate in shelter near human settlements, leaving only to feed and oviposit. The absence of adults from huts during the day and the reduction of the number of females visiting them by 60 per cent. in the night after the vegetation within 200 yards had been sprayed with DDT, supported this. The reappearance of the normal population the next night, indicated that new mosquitos had moved in from the breeding areas. Other observations suggested that the rate of infiltration by *A. punctulatus* is about 200 yards per day. At Cairns, where many adults of *A. farauti* were taken in the open at night, breeding grounds, sources of blood-meals and

diurnal resting places were concentrated in one area. Near Lae, *A. farauti* and *A. punctulatus* and intermediate forms occurred in large numbers in huts by day.

A. farauti was prevalent at Mirivasi, the only other Anophelines seen being *A. subpictus*, Grassi. Few Anophelines were observed until the strong trade winds subsided in the early hours of the morning, and unfed adults often rested in huts. By day, many adults rested near the ground under fallen palm fronds on sandy soil near one native village and under vegetation and débris on almost wet soil in a shaded area in another. Only one female was found by day in open huts but engorged ones were common in small, dark huts with closed doors and no windows, which presumably acted as traps. Although *A. farauti* was abundant and the gametocyte rate was 2·3 per cent. among adult natives and 17 per cent. in infants, the sporozoite rate in 1,737 females of *A. farauti* was only 0·06 per cent. Of 200 females of *A. subpictus*, one had oöcysts. Data are given on the wing and ovary stages of these females. Only a few of the females of *A. farauti* caught feeding, but a much higher proportion of *A. subpictus*, had had a previous blood-meal. It seems that the low infection rate in *A. farauti* was due to short life, resulting from unfavourable conditions.

From a study of the data obtained, it is concluded that the habits of *A. punctulatus*, *A. farauti* and intermediate forms have much in common. Males spend their lives in the bush, and the females are fertilised there and leave only for feeding and oviposition. Pyrethrum sprays applied indoors during the day would therefore be of little use against them, but DDT sprays applied to hut walls gave promising results because the females rest on the walls before and after feeding.

A. annulipes, Wlk., is well distributed throughout Australia, extends to New Guinea, and is extremely common. It is highly susceptible to experimental infection with *Plasmodium falciparum* and *P. vivax* [**32** 161] and on epidemiological grounds is considered the probable vector of sporadic malaria in areas outside the range of *A. farauti*. It was found to attack man viciously at night near the breeding area and readily enter houses and tents to feed. It rested during the day in tents, slit trenches and on the banks of creeks.

HADJINIKOLAU (J.) & BUSVINE (J. R.). **Toxicity of Limewash containing DDT or " Gammexane " to Mosquitos** (*Aëdes aegypti*, **L.**).—*Bull. ent. Res.* **39** pt. 1 pp. 179–183, 1 fig., 4 refs. London, 1948.

In many countries, houses have plaster or mud walls coated with limewash. To test the value of incorporating an insecticide with lasting properties in a wash applied each season, experiments were made with DDT (85 per cent. p,p′) and with a dispersible powder containing benzene hexachloride at a concentration equivalent to 5 per cent. γ isomer. They were applied in limewash or kerosene solution to 3·6 sq. ft. (about 60 per cent.) of the internal surface of small cages, and 100 adults of *Aëdes aegypti*, L., 2–5 days old, were confined in the cages for a fixed time at varying periods after treatment. The limewash was applied with a brush at 1·6 gm. lime and 6 cc. water per sq. ft. and the solution from a pipette at 10 cc. per sq. ft. The DDT was mixed with the limewash with the aid of 1 per cent. Teepol. The walls of the cage were of a highly absorbent material. Much of the untreated surface was occupied by floor, sleeve and windows, on which mosquitos seldom settle. After being confined for a short time in a cage treated with DDT, the mosquitos became restless and all showed characteristic signs of poisoning after an hour or two, but some usually recovered if they were then removed, and females offered a blood meal sometimes fed and laid viable eggs.

The results were somewhat variable. DDT in limewashes at 160 mg. per sq. ft. gave kills varying between 88 and 100 per cent. for males and 77 and 100

per cent. for females exposed for two hours 11–60 days after the cage was treated. The kill effected by the same dosage in kerosene or by 80 mg. in limewash was more variable and generally lower. Benzene hexachloride at 8 mg. γ isomer per sq. ft. gave 94 and 95 per cent. kill of males and 100 and 87 per cent. kill of females after exposure for one hour, one and six weeks after treatment, respectively. Exposure for ½ hour, was ineffective with this dosage. With 40 mg. per sq. ft., kill was consistently complete at 1, 6, 10 and 13 weeks with exposure for ½ hour and at 1, 13 and 22 weeks with exposure for one hour. Mortalities recorded after different exposures were reasonably consistent with the logarithmic-sigmoid curves typical of dosage-mortality relations.

Gracia Dorado (F.) & Cañadell Vidal (J. M.). **Parasitismo cutáneo por el *Pediculoides ventricosus*.** [Cutaneous Parasitism by *P. ventricosus*.]—*Rev. ibér. Parasit.* **6** no. 4 pp. 293–308, 6 figs., 27 refs. Granada, 1946. (With a Summary in English.)

An outbreak of dermatitis that occurred in September 1946 among workmen handling straw from Valencia at a glass factory near Barcelona was found to be caused by *Pediculoides ventricosus*, Newp., which was numerous in the straw, together with various grain insects. Descriptions are given of the symptoms observed, which were reproduced when the mites were allowed to feed on one of the authors, and of the adults of both sexes and the bionomics of the mite. Since the straw was too valuable to burn and too bulky to fumigate, part of it was dusted with DDT, which gave satisfactory control in 48 hours but was costly, and the remainder was allowed to lie in the open until the onset of winter destroyed the mites. The author considers that unrecognised cases of dermatitis due to *P. ventricosus* are probably frequent in Spain, although man is normally attacked only when insect larvae are not available. Two further cases were observed in the course of investigations near Barcelona, in people handling animal feeding stuffs on a farm. The mites were destroyed in a few days by adding a small quantity of DDT to the feeding stuffs.

Cañadell Vidal (J. M.). **Experiencias y ensayos con un nuevo producto insecticida : el dicloro-fenil-tricloroetano (DDT).** [Tests of a new insecticidal Product : DDT.]—*Rev. ibér. Parasit.* **6** no. 4 pp. 309–342, 6 figs., 23 refs. Granada, 1946. (With a Summary in English.)

The author reviews the relation between Arthropods and disease in man and the insecticides in use in Spain, and gives an account of the history, chemistry and physical properties of DDT. He describes the symptoms of poisoning by DDT in Arthropods and mammals from his own observations and from the literature [*R.A.E.*, B **32** 175, 179] and discusses its mode of action. The median lethal dose of pure DDT for rats and guineapigs was found to be 0·45 and 1·75 gm., respectively, per kg. body weight when administered orally, but a daily oral dose of 2 gm. per kg. Neocid (5 per cent. DDT in talc) for 10 days and a daily subcutaneous injection of 0·03 gm. DDT per kg. for 15 days, proved harmless to rats and guineapigs, respectively, and the daily application of up to 40 gm. Neocid per kg. to the skin, including the conjunctiva, over a period of 10 days was harmless to both. Cutaneous applications of up to 20 gm. per kg. Neocid during 10 days caused no harm to small birds.

A list is given of Arthropods of medical or veterinary importance that are known to be susceptible to DDT. Following laboratory tests showing the toxicity of DDT to lice, a dust of 5 per cent. DDT in talc was tested in the winter of 1944–45, at the average rate of about 1–1½ oz. per individual, on the bodies and clothing of persons in institutions in Barcelona who were infested

with *Pediculus humanus humanus*, L. (*P. h. corporis*, Deg.). For treating clothing, it was quicker and more convenient than fumigation with hydrocyanic acid gas and its toxicity persisted for several weeks if the clothes were not washed. Only 14 out of 524 persons were found to be infested 2–4 days after treatment, and it is thought that they had been reinfested through contact with untreated persons. In more than 40 cases, *Phthirus* (*Phthirius*) *pubis*, L., was also present; complete control of all stages of this louse was obtained; the eggs appeared shrivelled and discoloured after 24 hours and none hatched. An abundant application of the dust was also effective against *Pediculus humanus capitis*, Deg., on women's heads.

Further experiments were carried out against eggs, larvae and pupae of *Anopheles maculipennis*, Mg., and *Culex pipiens*, L., either taken in the field or reared in the laboratory. An emulsified solution of DDT applied to water to give 0·02 parts DDT per million killed the larvae and pupae of host species in about 36 hours, and water containing 0·1 and 0·05 p.p.m. DDT showed no diminution in toxicity to larvae of *Culex* in a test lasting a month. In deep water, cork dust impregnated with DDT at the rate of 1 : 1,000 and applied at a rate to give 0·3 oz. DDT per 10 sq. yards killed all larvae and pupae present in 10 hours. High concentrations of DDT did not prevent the eggs of *Culex* or *Anopheles* from hatching, but the resultant larvae were unable to develop even when the concentration was as low as 0·0166 p.p.m. Concentrations of 0·05 p.p.m. were harmless to aquatic plants and fish.

LEVER (R. J. A. W.). **Entomological Notes.**—*Agric. J. Fiji* **17** no. 1 pp. 9–15, 32 refs. Suva, 1946.

In the course of a note on mites from Fiji, it is stated that *Liponyssus bursa*, Berl., occurs there on poultry and pigeons [*R.A.E.*, B **33** 85]. *Tetrastichus hagenowi*, Ratz., which was recorded in 1943 as an egg parasite of *Periplaneta* [*americana*, L.] [**32** 38], is actually a hyperparasite, attacking egg parasites belonging to the genus *Evania*, of which *E. impressa*, Schlett., *E. subspinosa*, Kieff., *E. sericea*, Cam., and *E. appendigaster*, L., occur in Fiji.

Tests of DDT were made with solutions and powders all containing 5 per cent. A solution in benzene diluted with water (1 : 6) and sprayed on to the surface of water in a tank controlled larvae of *Culex* for 12–14 days. Routine spraying every two weeks prevented pupation, and eggs laid did not hatch. Sawdust impregnated with a diesel-oil solution and suspended in a bag in a disused swimming bath, prevented breeding by *C. sitiens*, Wied. Twine hanging from bottles suspended clear of the water also gave good results. In tests with 10 cc. diesel-oil solution in 3 quarts water in glass jars, a higher concentration than was used in the field, larvae of *Culex annulirostris*, Skuse, succumbed before *C. fatigans*, Wied., followed by *Aëdes vexans*, Mg., with *A. pseudoscutellaris*, Theo., and *A. aegypti*, L., surviving longest. Spraying gauze screens and the surrounding woodwork at a coast establishment with DDT in diesel oil markedly reduced numbers of *Culicoides mollis*, Edw., and the effect remained noticeable for three weeks. Rubbing Neocid powder (5 per cent. DDT) over the scalp with cotton-wool destroyed *Pediculus humanus capitis*, Deg. (*humanus*, Deg.) on the heads of Indian school girls. The hair was not to be oiled for three days. After 3½ months, there were only 36 cases of reinfestation among 196 girls. Spraying with a benzene solution controlled *Cimex hemipterus*, F., in beds. *Ctenocephalides felis*, Bch., on lawns was controlled by DDT in road dust or in kerosene, the solution being the more effective. Less decisive results were at first obtained against *Periplaneta americana* in houses, but a solution in diesel oil gave excellent control of large swarms in a concrete pit at a factory. Neocid gave good results against *Blattella germanica*, L., in a kitchen. Windows sprayed with the benzene solution

remained toxic to *Musca domestica vicina*, Macq., for as long as ten weeks. Application of a fine film to glass and wire-gauze cages showed that all flies dropped after 25 minutes and were dead in 2½ hours.

Olifan (V. I.). **Periodicity in the postembryonic Development of *Anopheles maculipennis*.**—*C.R. Acad. Sci. URSS* (N.S.) **55** no. 2 pp. 169–172, 2 figs., 12 refs. Moscow, 1947.

Larvae of *Anopheles maculipennis* vars. *messeae*, Flni., and *atroparvus*, van Thiel, were reared in tap water with yeast, infusoria and flagellates as food, and their respiration and rate of growth were observed. Measurement of the stigmatic and cutaneo-branchial respiration with a microspirometer gave the consumption of atmospheric oxygen and of that dissolved in water, respectively [*cf. R.A.E.*, B **14** 131]. The changes in respiration that took place with the increasing age in one set of tests are shown on a graph. It was found that respiration did not increase steadily with the age of the larvae but showed a succession of increasingly high peaks separated by depressions. As a rule, the depressions more or less coincided with the moulting periods, and the peaks with the middle of each instar. In some of the experiments, however, a peak was preceded by a deep depression in addition to that occurring during the moulting period. There was a particularly high peak in the third instar.

The growth of the larvae was studied by measuring their length each day and computing the true growth-rate to obtain a graphic representation of the changes that took place with age. The resulting curve showed a succession of decreasing peaks, indicating that the increase in length of the larvae with age was of an intermittent character; growth was considerably slowed down soon after the beginning of the third instar owing to accelerated differentiation, and this instar was preceded by unusually high mortality.

It is concluded that there is a definite rhythm in the intensity of respiration and growth in the larvae of *A. maculipennis* corresponding to profound changes in their metabolism and that the intensification of growth at the beginning of the third instar and of oxygen consumption in the course of it is suggestive of the particular importance of that instar. The periodicity observed in growth and metabolism is thought to be controlled by the rate of production of hormones.

Papers noticed by Title only.

Floch (H.) & Abonnenc (E.). **Clef d'identification de 140 phlébotomes mâles du nouveau continent.**—*Bol. Ent. venezolana* **6** no. 1 pp. 1–24, 2 refs. Caracas, 1947.

Pereira Barretto (M.). **Uma nova espécie de flebótomo da Colômbia e chave para a determinação das espécies afins (Diptera, Psychodidae).** [A new Species of *Phlebotomus* (*carrerai*, sp. n.) from Colombia, with a Key distinguishing the related Species.]—*An. Fac. Med. Univ. S. Paulo* **22** 279–293, 16 figs., 7 refs. São Paulo, 1946. (With a Summary in English.)

[Yaguzhinskaya (L. V.).] **Ягужинская (Л. В.). The Mechanism of Action of DDT on the Insect's Organism. (A Review of the Literature.)** [*In Russian.*] —*Med. Parasit.* **16** no. 1 pp. 88–90, 4 figs., 6 refs. Moscow, 1947.

Ripper (W. E.) & Tudor (P.). **The Development of a Helicopter Spraying Machine.**—*Bull. ent. Res.* **39** pt. 1 pp. 1–12, 8 pls., 4 figs., 10 refs. London, 1948. [See *R.A.E.*, A **36** 260.]

PEREIRA BARRETTO (M.). **Sôbre a sinonímia de flebótomos americanos (Diptera, Psychodidae). Segunda nota.** [Second Note on the Synonymy of American *Phlebotomus*.]—*An. Fac. Med. Univ. S. Paulo* **22** pp. 1–27, 22 figs., 19 refs. São Paulo, 1946. (With a Summary in English.)

Among the species of *Phlebotomus* (*Flebotomus*) of which the synonymy is here discussed are *P. gomezi*, Nitzu., and *P. shannoni*, Dyar; the adults of both sexes of each of them are described in detail. The author considers that *P. suis*, Rozeboom [*R.A.E.*, B **28** 218] is a synonym of *P. gomezi*; it was originally distinguished by the shape of the spermatheca, but that of the female from which *P. gomezi* was described [**19** 183] was apparently deformed, and the author has observed a similar deformation in an example from Brazil. Comparison of males showed that *P. limai*, Fonseca [*cf.* **25** 240; **30** 128] and *P. bigeniculatus*, Floch & Abonnenc, which was described from French Guiana, are identical with *P. shannoni*; some differences in the spermathecae of the females of *P. limai* and *P. bigeniculatus* are attributed to accident or to geographical variation.

RODHAIN (J.). **Essais d'infection de la cavité générale de la tique *Ornithodorus moubata* par divers trypanosomes.**—*Ann. Soc. belge Méd. trop.* **25** no. 1–2 pp. 1–17, 2 pls., 6 refs. Brussels, 1945.

Accounts are given of experiments on the infection of the body cavity of *Ornithodoros moubata*, Murr., by inoculation with *Trypanosoma vespertilionis*, *T. pipistrelli* and *T. cruzi*. The work with the first two trypanosomes has already been noticed [*R.A.E.*, B **33** 142]. The cultures of *T. cruzi* were injected through the cuticle of the ticks, a method that causes infection of the intestines as well as the body cavity; this trypanosome is known to establish lasting infections in the digestive tract of *O. moubata* [**6** 213], but a tick harbouring metacyclic forms does not seem able to transmit the infection while feeding. The injections caused a haemocoelic infection that lasted up to six months and was accompanied by a cytological reaction. Multiplication of the flagellates in the haemocoele was usually moderate, but one tick out of 38 showed an intense infection of the whole body cavity that apparently affected it adversely. Attempts to transmit infection from tick to tick by injection were unsuccessful. A batch of 11 infected ticks, including the one with the intense infection, transmitted *T. cruzi* to a guineapig on which they fed. Trypanosomes were never found in the saliva, but crithidial forms and trypanosomes were seen in the coxal fluid excreted by the ticks, and some of this fluid may have been ingested by the guineapig or have penetrated its skin. Ticks fed on mice infected with trypanosomes from the haemocoele developed intestinal infections only. Inoculation of 15 adults of *Argas reflexus*, F., with *T. cruzi* through the cuticle resulted in weak haemocoelic infection lasting less than 30 days.

CARPENTER (S. J.), CHAMBERLAIN (R. W.) & PEEPLES (L.). **Tick Collections at Army Installations in the Fourth Service Command.**—*Ent. News* **57** no. 3 pp. 71–76. Lancaster, Pa., 1946.

In 1943-45, 3,227 ticks were collected at army installations in 47 localities in the States of the Fourth Service Command (Alabama, Florida, Georgia, Mississippi, North Carolina, South Carolina and Tennessee). The species comprised *Amblyomma americanum*, L., *A. dissimile*, Koch, *A. tuberculatum*, Marx, *Dermacentor albipictus*, Pack., *D. variabilis*, Say, *Haemaphysalis leporis-palustris*, Pack., *Ixodes scapularis*, Say, *Rhipicephalus sanguineus*, Latr., and

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Ornithodoros turicata, Dugès. The localities at which each was found, with the number of individuals taken and their stage of development, the date of capture and the host or method of collection, are shown in a table.

WATSON (R. B.). **Observations on the Transmissibility of Strains of *Plasmodium vivax* from Pacific War Areas by *Anopheles quadrimaculatus*.—*Amer. J. trop. Med.* 25** no. 4 pp. 315–321, 5 refs. Baltimore, Md., 1945.

The following is almost entirely based on the author's summary. By transferring blood to patients requiring malaria therapy, six strains of *Plasmodium vivax* were isolated from soldiers who had returned to the United States from Pacific war areas, where they had presumably acquired their infections. The clinical and parasitological characteristics of the induced infections were not unlike those of infections with the indigenous (McCoy) strain of *P. vivax* used for reference. Some of the patients known or thought to have been previously infected with *P. vivax* showed considerable immunity from Pacific infections and four of them were refractory. Females of *Anopheles quadrimaculatus*, Say, were fed on the patients with induced infections when the number of gametocytes in the blood seemed favourable, and were examined for sporozoites after a minimum period of 17 days. Females fed on patients infected with three of the six strains had sporozoites in the salivary glands when examined and transmitted the infection by biting. It is suggested that hot dry weather may have caused the failure of the other three strains to produce gland infections [*cf. R.A.E.*, B **29** 59]. In a subsequent study of two of the strains that infected the mosquitos, gland infections sometimes developed after the mosquitos had fed on patients with submicroscopic gametocytaemia. A smaller proportion of the mosquitos exposed to the Pacific strains than of those exposed to the control strain developed heavy gland infections. It is concluded that at least some of the Pacific strains of *P. vivax* can be transmitted by *A. quadrimaculatus* [*cf.* **36** 1] but that it may be a somewhat less efficient vector of these strains than of the McCoy strain.

CAUSEY (O. R.) & BRITTO MELLO (G.). **Malaria in the Amazon Valley of Brazil during 1942 and 1943.**—*Amer. J. trop. Med.* **25** no. 4 pp. 323–327, 1 map, 1 graph, 2 refs. Baltimore, Md., 1945.

Two malaria parasite surveys were made in towns by the waterways and in farming country in the Amazon Valley of Brazil, one in December 1942 at the end of the dry season, when the prevalence of malaria was expected to be lowest and before control or prophylactic measures were undertaken, and the other in June 1943 at the end of the wet season, when incidence would be expected to be greatest. The valley and its climate and the technique used are described, and the results discussed in detail. The parasite rate was 5 per cent. in the December survey, which involved 19,629 people in 23 towns and villages, and only 3·3 per cent. in the June survey, involving 27,103 people in 37 localities. The low rate in June is attributed mainly to the distribution of atebrin throughout the valley and to the anti-mosquito work that had been begun in many localities [*cf. R.A.E.*, B **36** 39], but a malaria cycle of several years' duration may also be involved. There is some evidence of such a cycle in many of the areas where the chief vector, *Anopheles darlingi*, Root, is always present. Where this species is transitory, the cycle cannot occur, as it can function only where the immunity factor in the human population is the only variable. With the exception of the coastal species, *A. aquasalis*, Curry, *A. darlingi* is the only Anopheline able to produce epidemic malaria in the Amazon valley [*cf.* **36** 5]. It breeds most prolifically during and immediately after the rainy season and can pass the dry season only in areas where there are permanent lakes or ponds, from which it disperses to the surrounding country with

the beginning of the rains. In localities in which the resistant foci occasionally dry up in a particularly long dry season, *A. darlingi* may die out. The duration of its absence depends on the proximity of other resistant foci or the chances of reintroduction. When it reinfests areas from which it has been absent for some years, it causes severe malaria epidemics among the relatively non-immune population. The fact that it is limited during the dry season to large bodies of water or swampy regions, many of which can be drained or effectively treated with Paris green or oil, should make it comparatively easy to eradicate, and its eradication from dry-season breeding areas near the towns and villages to be protected would be the most economical anti-malaria measure in many parts of the Amazon Valley.

WADDELL (M. B.). **Persistence of Yellow Fever Virus in Mosquitoes after Death of the Insect.**—*Amer. J. trop. Med.* **25** no. 4 pp. 329–332, 3 refs. Baltimore, Md., 1945.

As the isolation of virus from mosquitos taken in nature is of importance in the epidemiological investigation of jungle yellow fever, studies were undertaken to determine whether mosquitos that had died in transit to the laboratory could be used for the isolation of virus and whether the methods used to kill mosquitos had any deleterious action on the virus. After death, the mosquitos were kept at 26–30·5°C. [78·8–86·9°F.]. The methods used are described. Significant amounts of yellow-fever virus were recovered from *Aëdes aegypti*, L., as much as 4, 17·5, about 20 and 45·5 hours after death from exposure to ether, starvation, tobacco smoke and potassium cyanide, respectively, but most virus activity was lost in 30 minutes after death from exposure to chloroform, and none remained after an hour. Exposure to chloroform at a concentration sufficient to immobilise the mosquitos for two hours did not significantly diminish their virus content, but in practical work, it is difficult to avoid exceeding the critical dose. Taking convenience into account, ether is regarded as the best killing medium. Virus was recovered from a significant number of lots of *Haemagogus equinus*, Theo., and *H. spegazzinii*, Brèth., that died during laboratory transmission experiments.

WISSEMAN jr. (C. L.). **Relapsing Fever in Denton County, Texas. Report on finding the Tick, *Ornithodorus turicata*, naturally infected.**—*Amer. J. trop. Med.* **25** no. 4 pp. 339–342, 2 figs., 9 refs. Baltimore, Md., 1945.

Nymphs and adults of *Ornithodoros turicata*, Dugès, were found in some numbers in 1944 in a cave in Denton County, Texas, in which H. A. Kemp and his associates had failed to find ticks infected with relapsing-fever spirochaetes in several years' work, although they found uninfected ticks and human cases of the disease had been traced to the cave before 1931 [*R.A.E.*, B **22** 246]. The ticks found in 1944 were most numerous where the floor of the cave was dry and rodent droppings most plentiful. Some were naturally infected with relapsing-fever spirochaetes and transmitted them to man and white rats while feeding. Possible explanations of the apparent disappearance and reappearance of the infection in the neighbourhood are suggested.

COLE (L. C.). **The Effect of Temperature on the Sex Ratio of *Xenopsylla cheopis* recovered from live Rats.**—*Publ. Hlth Rep.* **60** no. 45 pp. 1337–1342, 14 refs. Washington, D.C., 1945.

It is generally accepted that the infectibility of a locality with plague is proportional to the local population of *Xenopsylla cheopis*, Roths., and that this can be adequately estimated by counting the fleas on trapped rats, though

they are known to spend much time off the host. The effect on flea counts from rats of various factors other than the actual flea population was considered in a recent paper [*R.A.E.*, B **35** 10], and the investigation described in the present one was carried out to examine the effect of air temperature on the proportion of the population of *X. cheopis* on the hosts in nature, and the value of changes in the sex ratio as indicators of changes in the balance between fleas on rats and away from them. Data from Mobile, Alabama, Jacksonville, Florida [*loc. cit.*], Honolulu, Hawaii and San Diego, California, were examined.

Although there was evidence that the sexes occur in equal numbers in nature, totals of 36,163 females and 36,283 females being obtained from the rats in the four cities, there was a highly significant tendency in each city for males to predominate on hot days and females on cold days. The response to temperature changes apparently required less than 24 hours, and probably indicated relatively more frequent feeding by the males in hot weather, when fleas must feed oftener than in cold weather in order to survive. Thus, the proportion of the total flea population found on the hosts is presumably somewhat increased by high temperatures, but the increase is smaller for females than for males. This suggests that the count of females may bear a more stable relationship to the total flea population than does the total flea count and that consideration might be given to using an index computed for females only in epidemiological work.

Equal numbers of the two sexes were found on the rats at a lower temperature in San Diego than in the other cities. It is, therefore, apparent that some factor other than mean daily temperature, perhaps dryness [**13** 128–129], influences the ratio.

NEUJEAN (G.). **Etudes sur les rickettsioses. I. Note préliminaire.**—*Rec. Trav. Sci. méd. Congo belge* no. 4 pp. 5–9. Léopoldville, 1945. **II. Problèmes posés. Critique des méthodes. Nouveaux procédés de diagnostic et de recherche.**—*T.c.* pp. 10–22.

The conclusions drawn in Ruanda-Urundi in 1939–40 [*R.A.E.*, B **33** 90] on the etiology of typhus in the Belgian Congo are supported by the observations described in the first paper, which were made at Kasai and Leopoldville in 1944. The causal agent was weak and of the murine type, but had certain characters differentiating it from the usual murine agent. Strains isolated from lice [*Pediculus humanus humanus*, L.], *Cimex hemipterus*, F., fleas and ticks caused similar reactions in inoculated animals. In many cases, the most likely vector seemed to be *C. hemipterus*. The percentages of rats infected were very high. The Weil-Felix reaction was constant throughout the investigations. Agglutination was principally of Proteus X 19 and the reaction scarcely persisted after recovery but appeared early and seemed highly specific. In the late years, however, positive reactions with Proteus XK became increasingly frequent. The only Proteus isolated from blood and urine and agglutinatable by sera of typhus patients were of the type XK. The results of pathological and clinical observations are given. Typhus has existed in the country for a long time and has occurred in widely scattered areas since the epidemic in Ruanda-Urundi in 1934–35 [**23** 298]. The usual type is mild, but there are also rickettsial infections that attack certain organs, such as the liver or lungs, and are often fatal. These two types seem to co-exist in time and space and this the author interprets as evidence that they are caused by a single rickettsia, which must be very unspecialised and capable of being transmitted by many different Arthropods.

Rickettsial diseases were also seen in cattle, sheep, goat, and dog and latent infections in dogs, cats, monkeys, rabbits, rats, etc. Positive Weil-Felix

reactions were obtained with dogs. It is concluded from a study of morphology that both rickettsiae of domestic animals and also a typhus rickettsia are involved.

PARENT (M.) & VINCKE (I.). **Notes entomologiques (Diptera : Anophelinae).**—*Rec. Trav. Sci. méd. Congo belge* no. 4 pp. 23–24, 2 figs. Léopoldville, 1945.

Descriptions are given of the distinctive features of the pupae of *Anopheles coustani* vars. *coustani*, Lav., *tenebrosus*, Dön., and *ziemanni*, Grünb., and *A. natalensis* var. *multicinctus*, Edw., and of variation noted in the larva of *A. implexus*, Theo., all from the Belgian Congo. No constant differences were found between the pupae of var. *coustani* and var. *ziemanni*, but those of var. *tenebrosus* were easily distinguishable from them.

LEWILLON (R.). **Le piégeage expérimental de *Glossina palpalis* à la Mission Médicale du Kwango.**—*Rec. Trav. Sci. méd. Congo belge* no. 4 pp. 45–57, 6 figs., 6 refs. Léopoldville, 1945.

Harris traps gave inconsistent results when tested against *Glossina palpalis*, R.-D., in the Belgian Congo in the past [*cf. R.A.E.*, B **21** 236; **22** 158; **23** 13; **28** 75], and they exercised practically no attraction when tried again near Kikwit in the Kwango district from 18th August to 13th October 1941, while the fly-boys were being persistently attacked. This observation led to the construction of man-like traps, designed to resemble the human form, and their trial in the Kwango over a period of 11 months. Various models were made of which one is described in detail. It consisted of a skirt of black raffia cloth about a yard long hanging down from a horizontal rectangular plank (10×17 ins.), which had a square hole in the centre giving access to a one-way entrance of wire gauze leading up into a cage formed by a hollow gourd in which numerous small holes had been pierced to admit the light. The skirt was kept open at the bottom by a wooden frame, the outside dimensions of which were the same as those of the plank. The whole was suspended from a pole supported on two uprights. Flies leaving shelter were attracted by the dark human outline of the trap, which swayed and spun round slowly with the slightest wind, and eventually went under the cloth as they go under skirts or trousers in search of a meal. Finding no source of food, they were attracted to the light shining through the gourd. Two of the traps described by Swynnerton [**21** 114] were built for comparison. These were the single-screen trap, consisting of a dark screen hanging from a catching cage of mosquito netting, with and without a short skirt, and a modification of the living-bait (dark to light) trap, in which a pig was confined in a solid enclosure, with apertures covered with mosquito netting, surmounted by a dark-coloured tent with the catching cage at the top. *G. palpalis* is attracted to the second trap by the scent of its favourite host, alights on the walls, and, being unable to reach the animal, flies up towards the light and thus enters the cage.

In the first trial, made at Kikwit, Harris and man-like traps took 0·007 and 0·29 tsetse-flies per trap-day, respectively. In the next, at the village of Bembele, an acute focus of sleeping sickness, 123 tsetses were taken in 27 days in the village and 182 in 151 days by the neighbouring river, with no catch in the following month. In the village, 106 were taken in a Swynnerton trap with living bait, 17 in a single screen and a man-like trap, and none in a Harris trap. By the river, Harris traps caught much fewer flies per trap-day than man-like traps, but these were only slightly inferior to single-screen traps. Baited traps were not tested. At a heavily infested ferry, at which a man-like trap was

installed on 17th December, 944 tsetses were taken on the first three days and 352 on the next five. A second trap was installed on the ninth day. By 2nd June, 4,780 tsetses had been taken, and the index per trap-day fell from 315 for the first three days to 1 for the last 18 with an average of 17·3. In April, only 3–4 tsetses were seen where there had been swarms before trapping began, and these were not aggressive, presumably because the reduced population could support itself easily on game without attacking man, which is not a favourite host. Two traps set up at a highly infested company station took 5,370 tsetses in 158 days, giving effective protection against constant re-introduction of *Glossina* by traders, and at a Mission, where likewise the *Glossina* population was being constantly renewed, 3,820 were taken in the first 196 days with two traps, which thereafter took 300–450 per month. The results obtained in these and other localities differing in intensity or original infestation are given in tables.

As *Glossina* has a very low reproductive capacity, usually lives in colonies numbering only some hundreds or thousands, has easily located hunting grounds and can easily be taken in traps of the kinds tested, attack against the fly appears to be a reasonable method of controlling sleeping sickness. Unlike other species, *G. palpalis* can be trapped at all times of the year. It is concluded that trapping of this species should be carried out systematically wherever the nature of the country permits. In most cases, the man-like trap is preferable when economy and ease of construction and operation are taken into account, though the costliness and complication of the dark to light animal trap are largely offset by its greater effectiveness, and its construction might be improved. The use of the latter trap is advocated in bad foci of sleeping sickness in which the density of *Glossina* is very low, and in places where females comprise less than half of the catch in a man-like trap or where results have to be obtained in a limited time.

WOLFS (J.). *Anopheles* (*A.*) *implexus* **var.** *henrardi* **Wolfs. Description du mâle.**—*Rec. Trav. Sci. méd. Congo belge* no. 4 p. 67. Léopoldville, 1945.

The male of *Anopheles implexus henrardi*, Wolfs, is described. It is stated to differ from *A. implexus*, Theo. [of which De Meillon considered it a synonym on the basis of the variability of the characters in the female (*R.A.E.*, B **36** 60)] in that it is smaller and golden yellow (while *A. implexus* has many more scales that are creamish-white), and has a much narrower basal ring on the third segment of the palp. It does not differ in genitalia except in certain details.

DELVILLE (J.). **Infection naturelle d'***Anopheles demeilloni* **par oocystes de** *Plasmodium*.—*Rec. Trav. Sci. méd. Congo belge* no. 4 p. 112. Léopoldville, 1945.

In 1941, 14 examples of *Anopheles demeilloni*, Evans, were taken in native dwellings at Astrida (Ruanda), and oöcysts, probably of *Plasmodium falciparum*, were found in one of the six females dissected. Natural infection had not previously been recorded in this species. The other Anophelines taken in the dwellings comprised 16 examples of *A. christyi*, Newst. & Cart., 15 of *A. marshalli*, Theo., 8 of *A. funestus*, Giles, 8 of *A. squamosus*, Theo., 3 of *A. coustani*, Lav., and 2 of *A. gambiae*, Giles.

WANSON (M.) & HENRARD (C.). **Habitat et comportement larvaire du** *Simulium damnosum* **Theobald.**—*Rec. Trav. Sci. méd. Congo belge* no. 4 pp. 113–121, 3 refs. Léopoldville, 1945.

The bionomics of *Simulium damnosum*, Theo., in the region of Leopoldville, Belgian Congo, were studied from 1940 to 1944 in view of the increasing local importance of *Onchocerca volvulus* [see next abstract]. The females were found

to migrate upstream from their breeding places to the inhabited districts, by way of the tree- and grass-grown banks of the river Congo and its tributaries. They rested on the way among the vegetation, particularly *Paspalum*, and took shelter during rains and high winds, but travelled in calm weather or with light wind. They regularly migrated some 9–12 miles from their breeding places, the most important of which were in rapids in funnel-shaped branches of the Congo between islands and the banks. These are described in detail. From 15th September to 15th January, the beginning of the hot season and period of highest water, the density of larvae was greatest among vertical supports. The chief of these are the stems of *Pennisetum nodoflorum*, mostly in water 6–9 ft. deep, and the hurdles used by native fishermen in water 4–6 ft. deep. There were comparatively few larvae on the horizontal supports provided by Podostemaceae and stones, which, however, were used when the water level was less than 4 ft. The choice of site is determined by depth of the water, which must not be great, and by the swiftness of the current, which must be within the range of 2–3 miles an hour so as to assure a high degree of aeration of the water (rH=19) and yet not detach the larvae from their supports. Sudden changes in water level are often fatal. Larvae on vertical supports can move up or down to the most favourable position as the level changes, but pupae died at a depth of 28 ins. or more for want of oxygen. Control by a slow rise in water-level is unusual, but the adult population decreases conspicuously following the sudden fall in level in the middle of January, which exposes eggs, larvae and pupae to desiccation. There is close co-ordination between high water and maximum adult density between October and the middle of January and the minor rise in water level and adult populations from March to May. In 1943, an abnormally dry year, the water level remained low from April to August, but adults were unusually abundant during this cold season, because breeding became possible on the rocky river bed.

Observations on the development cycle were made in artificial breeding places in the river. In these, 18 egg batches were laid on floating hurdles, 13 on vertical hurdles and four on stones. After a small rise in water level, larvae that had hatched on stones migrated to a vertical hurdle. The batches comprised 200–250 eggs and were deposited on damp parts of the support at the surface of the water. The larvae hatched within four hours of oviposition, and their number was always reduced to about one-fifth on the same day. It is presumed that the current swept away the rest when they were leaving the egg. There was no evidence that these larvae could fix themselves further downstream. The larval stage lasted five days with six moults and the pupal stage four days, irrespective of season. Control measures should therefore be carried out weekly. Males were two or three times as numerous as females and emerged a few hours before them. The emerging adult is carried to the surface of the water by a bubble of air under the wings. If water movement prevents it from coming to the surface at once it drowns.

In tributary rivers, *S. damnosum* breeds usually in the lower reaches where the current is strongest. These breeding places on the outskirts of the town enable females to oviposit during their migration or at the end of it. Larvae and pupae attach themselves at all depths down to 10 ins. below the surface of the water on the leaves, stems and roots of the ordinary river vegetation, and also on stones, dead wood and old iron. As in the river Congo, they fix themselves side by side and often form patches on the surface of their supports. The larvae and pupae of the other species of *Simulium* found are always scattered over the supports, and never associated with those of *S. damnosum*. They prefer the less aerated water of the upper reaches. Pupae of *S. damnosum* from tributaries often had elongated respiratory filaments.

Study of the contents of the digestive tract of the larvae showed it to include a considerable quantity of plankton, principally long needle-shaped, green

diatoms together with green and blue-green algae. In one tributary only, the larvae were parasitised by microsporidians. Half were affected, and heavily parasitised ones failed to pupate, while others were unable to detach themselves from their supports.

WANSON (M.), HENRARD (C.) & PEEL (E.). *Onchocerca volvulus* **Leuckart. Indices d'infection des simulies agressives pour l'homme. Cycle de développement chez** *Simulium damnosum* **Theobald.**—*Rec. Trav. Sci. méd. Congo belge* no. 4 pp. 122–138, 8 figs., 5 refs. Léopoldville, 1945.

The species of *Simulium* that attack man in the region of Leopoldville are *S. damnosum*, Theo., and *S. albivirgulatum*, Wanson & Henrard. The former is the vector of *Onchocerca volvulus* ; the females travel a long distance from the breeding place and assure transmission over an area with a radius of six miles at least. *S. albivirgulatum* breeds in sluggish rivers, remains near its breeding places and apparently plays no part in transmission. Of well over 2,000 females of each species taken on man in various parts of Leopoldville, only 0·53 per cent. of *S. albivirgulatum* contained larvae and these had not developed beyond the sausage stage, whereas 6·2 per cent. of *S. damnosum* contained larvae in various stages and 1·76 per cent. contained infective larvae.

Natives living near the principal breeding site of *S. damnosum* in the river Congo [see preceding abstract] are constantly exposed to bites, and nearly all adults were infested with microfilariae, many with large numbers ; 58 per cent. had cutaneous signs of infestation or cysts and 5 per cent. had ocular complications. Dissection of females of *S. damnosum* from these villages showed that 15·3 per cent. were infested and 2·7 per cent. contained larvae that had reached the infective stage. The percentage of the population infested decreased as the distance from the rapids increased and the percentage infestation of *S. damnosum* became practically nil from about 7½ miles from these main breeding sites, although the range of spread of the adults extended much beyond this. Simuliids breeding in tributaries apparently did not affect the percentage of infestation in adult natives.

An account is given of the technique used for feeding females of *S. damnosum* in the laboratory and maintaining them long enough for the development of *O. volvulus* to be studied. Adults were allowed to emerge from pupae collected on pieces of stems of *Pennisetum nodoflorum*, and the females, which were easy to distinguish because the males have red eyes, were given a blood-meal after being kept without food for 18–24 hours. It was found necessary to place a little sugar solution on the scarified skin to induce *S. damnosum* to feed on it, whereas *S. albivirgulatum* would feed readily on blood without inducement after fasting for 18–24 hours. After one blood-meal, sugar solution was the only food given.

O. volvulus completed its development in *S. damnosum* in 6–7 days. A very large percentage of the females fed on two of the three natives used as donors became infected, and blood in their stomachs contained many more microfilariae than were obtained by scarification of the skin at the site of feeding. Many of these microfilariae were eliminated in 24–48 hours. They were found immobile in the stomach, when others had reached the thoracic muscles. Many reached these muscles and some even the head in 2–4 hours. Those that reached the head did not continue their evolution there. The sausage stage occurred normally in the thoracic muscles only, and was reached on the second day. The number found in one individual varied from one to 30, with an average of about five. There was very little mortality after the thoracic muscles had been reached. Mortality among the Simuliids was heavy during the first few days, probably because of heavy parasitism. The measurements of *O. volvulus* for each day of development are given. Full-grown larvae were found in the

head, and even sometimes in the posterior part of the abdomen as well as in the proboscis. Whereas a high rate of infection was found in females of *S. damnosum* dissected 6–8 days after an infective meal, only a very low rate was found in those dissected after 9–11 days. It is presumed that the latter had lost their infection while feeding on sugar solution.

Out of 14 females of *S. albivirgulatum* dissected 1–3 days after an infective meal, eight contained microfilariae or sausage forms, but no parasitism was found among 25 dissected on the five following days.

DETHIER (V. G.). **Chemical Insect Attractants and Repellents.**—9¼×6 ins., xv+289 pp., 69 figs., many refs. Philadelphia, Pa., Blakiston Co., 1947. Price $5.

This book is designed to elucidate the basic principles underlying the action of substances that attract or repel insects and is a compilation of information on the chemical, physical, physiological and botanical factors involved, together with interpretations and evaluations of existing work in the light of these principles. Since specific chemoreception is regarded as a unit of behaviour on which practical measures might be based, the chemical aspect is stressed, but an introductory chapter includes notes on other types of stimuli. Four chapters on the sources, chemistry and influence on insect behaviour of the various kinds of chemical attractants that occur in nature include one on the decomposition products of fats and proteins that attract necrophagous, sarcophagous and blood-sucking insects and insects that feed on fungi and algae. Other subjects dealt with include repellents and the ways in which they are utilised in insect control, apparatus and methods for measuring the responses of insects to odours, the chemical basis of taste and olfaction, and the uses made of traps and baits in insect control and the factors influencing their effectiveness.

LEPIGRE (A. L.). **Technique de la désinsectisation.**—270 pp., 31 figs., 21 pp. refs. Algiers, the Author, 1947.

This handbook is concerned primarily with the control of insect pests by fumigation, but notes on the importance of the principal categories of medical and veterinary pests and other control measures available against them are the subject of preliminary chapters. A longer chapter gives instructions for treatments against pests that attack man or domestic animals or are found in buildings. Others include information on heat treatments; the properties and uses of DDT, benzene hexachloride, rotenone, pyrethrins and various fumigants; warning gases and their use in fumigation; the ways in which fumigation technique and dosage rates are influenced by the physical properties of gases, temperature, humidity, the nature of the premises in which the treatment is to be carried out and the distribution of the commodities within them; the types of containers suitable for fumigants and other insecticides; and the equipment needed for their application. The book also contains lists of materials and equipment for mobile fumigation units, notes on the detection of toxic gases, detailed instructions for the treatment of cases of poisoning by fumigants, and a chapter on the French legislation relating to certain fumigants.

FREAR (D. E. H.). **A Catalogue of Insecticides and Fungicides. Volume I. Chemical Insecticides.**—*Ann. cryptog. phytopath.* **7** xi+203 pp., frontis., 14½ pp. refs. Waltham, Mass., Chronica Botanica Co.; London, Wm. Dawson & Sons, Ltd., 1947. Price $6.50 or 39*s*.

This is a first volume of a catalogue designed to present data concerning some 10,000 compounds tested against insects and fungi before 1944, obtained from

published and unpublished reports. The greater part of it consists of a list of chemical insecticides, in which the name and, in most cases, the chemical formula of each is followed by the insects against which it has been tested and, where possible, the concentration at which it was employed, an indication of its toxicity, and bibliographical references (including references to patents). The compounds are arranged according to a numerical coding system explained in the introduction ; basic code numbers enable the number for any particular compound to be worked out from its chemical composition. There are also the bibliography and a list of patent numbers arranged by countries.

MÜLLER (P.). **Relations entre la constitution chimique et l'action insecticide dans le groupe du dichlorodiphenyltrichloréthane et dérivés apparentés.**— *Rep. 1st int. Congr. Plant Prot. Heverlee 1946* pp. 97–109. Heverlee [? 1947].

Since the insecticidal action of DDT and related compounds may be due to a chemical change in the molecule, such as the liberation of hydrogen chloride, or to the arrangement of the groups of atoms in it, experiments were carried out with a large number of the compounds to compare their insecticidal action and their ability to liberate HCl [*cf. R.A.E.*, B **35** 101, etc.].

In the insecticidal tests, blowflies (*Calliphora vomitoria*, L.) were the chief test insects. The compounds were dissolved in acetone at concentrations of 10, 5 and 1 gm. per litre, and 1 cc. of solution was put into the base and the lid of each of a number of petri dishes. One hour after the acetone had evaporated, five flies were put in each dish and the times taken to paralyse and kill them at a temperature of 22°C. [71·6°F.] observed. To measure the liberation of HCl, 0·01 gm. molecule of each compound was dissolved in 250 cc. alcohol, 25 cc. of a normal alcohol solution of potassium hydroxide was added, and the mixture was allowed to stand for 16 hours at room temperature and then titrated with phenolphthalein.

With the exception of the hydroxy analogue, all analogues of DDT (4,4′-dichlordiphenyltrichlorethane) obtained by substitution in the two para positions were toxic ; the fluorine analogue was more toxic than DDT and the methoxy analogue about as toxic as the latter. The toxicity of alkyl derivatives decreased as the chain of carbon atoms lengthened. Substitution of chlorine for hydrogen on the aliphatic radical of DDT gave a non-toxic compound. When two methyl radicals were substituted on each phenyl radical of diphenyltrichlorethane to form a symmetrical compound, the 3,4-analogue was active, but the 2,4- and 2,5-analogues completely inactive. Asymmetrical substitution resulting in 4-chlordiphenyltrichlorethane, 4-chlor-4′-methyldiphenyltrichlorethane, 4-chlor-4′-n-propyldiphenyltrichlorethane and 4-chlor-3′-,4′-dimethyldiphenyltrichlorethane gave compounds similar in toxicity to DDT, but 4-acetodiphenyltrichlorethane was inactive. Of the three isomers of DDT, 4,2′- and 2,2′-dichlordiphenyltrichlorethane were noticeably less active than the 4,4′-compound, whereas the 4,3′-compound had an action slmilar to it.

Of the symmetrical di-substituted derivatives of diphenyldichlorethane, which was itself inactive, those containing bromine or methoxyl in the para positions were less active than the corresponding chlorine, fluorine and methyl compounds, which were similar in toxicity to DDT. In contrast to that of DDT, the toxicity of the chlorine compound (DDD) was not affected by substitution of chlorine for hydrogen on the aliphatic radical. Bis-(4-chlor-2-methylphenyl)-dichlorethane and the three symmetrical isomers of bis-(dimethylphenyl)-dichlorethane were all inactive.

The chemical tests showed that all derivatives with chlorine, bromine or fluorine in the two para positions liberated about 1 gm. molecule of HCl,

whereas the 4,4′-dimethoxy or dimethyl derivatives liberated only 0·3 gm. molecule. All the tetra-substituted derivatives liberated little or no HCl, although they varied from inactivity to great toxicity against insects. The DDD series gave similarly contradictory results, diphenyldichlorethane, which liberated much HCl, being completely inactive as an insecticide, whereas 4,4′-dimethyldiphenyldichlorethane, which liberated practically none, was active, and it is concluded that it is impossible to estimate any relation between liberation of HCl and insecticidal activity.

Kusters (C.). **Sur la chloruration des noyaux benzénique et naphtalénique en vue de l'obtention d'insecticides.** —*Rep. 1st int. Congr. Plant Prot. Heverlee 1946* pp. 117–132, refs. Heverlee [? 1947].

The author reviews the methods by which the molecules of organic compounds react with chlorine, and describes the chlorination of benzene and naphthalene by substitution and by addition, and of phenol and the cresols by substitution, the synthesis of DDT, and the production of nitro- and chlor-derivatives of DDT. He discusses the contact action of the insecticides formed by these methods and concludes that mono-substituted derivatives of benzene and naphthalene are more toxic than the original compounds, and that the degree of toxicity depends on the radical introduced, the CH_3, NH, NO and OH radicals being increasingly effective. Di- or tri-substituted compounds are generally more toxic than mono-substituted ones, and those with two different radicals than those with two similar ones. Combinations of two or more benzene rings or derivatives of them are more toxic than single ones. Iodine, bromine and chlorine derivatives are decreasingly effective. It has been shown experimentally that the chlorination of benzene or naphthalene by addition or substitution results in insecticidal compounds, the insecticidal properties generally increasing with the percentage of chlorine, and the para position being most favourable for dichlor-derivatives ; that the introduction of the NO_2 radical into a chlorine derivative increases its insecticidal effect ; that the structural arrangement of the compound has a considerable influence on its activity ; and that the insecticidal action of the different products is specific for certain groups or species of insects.

It is pointed out that upon chlorination, toxicity increases from monochlorbenzene to dichlorbenzene and is greatest for benzene hexachloride (hexachlorcyclohexane) ; that chlorination of phenol produces trichlorphenol and pentachlorphenol, both of which are very active ; that the derivatives of cresol have a powerful insecticidal action, but also a caustic effect ; that the substitution compounds of naphthalene are very toxic to both insects and mammals ; and that the addition compounds of naphthalene, though less active, give rise to interesting nitrated derivatives, which are being studied. It is also emphasised that the chlor- and nitro-derivatives of DDT are very effective.

West (T. F.). **Mode of Action of newer synthetic Insecticides.**—*Rep. 1st int. Congr. Plant Prot. Heverlee 1946* pp. 193–197, 13 refs. Heverlee [? 1947].

The author reviews hypotheses as to the mode of action in insects of DDT [*cf. R.A.E.*, B **35** 101], and states that although the mode of action of chlordane (1068) has not been dealt with in publications, he is under the impression that the second of these hypotheses [*loc. cit.*] suggested the investigations that led to its discovery [**35** 50]. Reference is made to experiments on an ascomycete that have supported the suggestion that the γ isomer of benzene hexachloride is taken up by the organism and gains general access to its cells because this isomer is molecularly very similar to isositol [**33** 131 ; but *cf.* **36** 99].

GEURDEN (L. M. G.). **Vergelijkend onderzoek over de werking van D.D.T. en gelijkaardige producten op de duiventeek** (*Argas reflexus*). [Comparative Test of the Effect of DDT and similar Products on the Pigeon Tick (*A. reflexus*).]—*Rep. 1st int. Congr. Plant Prot. Heverlee 1946* pp. 316–318, 4 refs. Heverlee [? 1947].

In a laboratory test in Belgium, engorged adults of *Argas reflexus*, F., were placed separately in glass tubes in direct contact with very small quantities of various dusts and examined microscopically every 24 hours. The periods required for mortality (of five ticks) averaged 340·8 hours for 10 per cent. DDT, 470·0 hours for 10 per cent. benzene hexachloride, 732·0 and 388·8 hours for benzene hexachloride treated with chlorine and nitric acid, respectively, and 264·0 hours for a dust containing 4 per cent. DDT and 0·1 per cent. γ benzene hexachloride with no mortality in the controls.

EMERY (G. A.). **Some recent Experiments in the Use of synthetic Insecticides.**—*Rep. 1st int. Congr. Plant Prot. Heverlee 1946* pp. 351–358. Heverlee [? 1947].

In the concluding section of this paper, the rest of which is noticed elsewhere [*R.A.E.*, A **36** 283], it is stated that results so far obtained in experiments in England with DDT for protecting sheep from infestation by the blowfly, *Lucilia sericata*, Mg., have indicated that sprays are effective and economical in use. The sprays contained a 20 per cent. wettable powder or a 50 per cent. paste containing no other insoluble material, both diluted to give 0·5 per cent. actual DDT ; the paste appeared likely to be the more satisfactory, owing to the smaller amount of deposit on the wool. Of various methods of application tested, the most satisfactory and economical was to employ a power sprayer, such as is used for fruit trees, with a pressure of 300–500 lb. per sq. in. ; the sheep was driven into a pen of four hurdles so that it could not turn round, while one operator at each side sprayed with a coarse, drenching spray the back, sides, tail and hind quarters, using about 6 pints spray per sheep before shearing or about 3 pints after shearing. Good results were also obtained with a stirrup pump, though this method is slow and tedious. The few examples of strike that were observed on sprayed sheep were of an unusual nature, for example, on a small injury on the head, and in nearly every case the maggots failed to develop.

Fish and Yabbies killed with D.D.T.—*Agric. Gaz. N.S.W.* **58** pt. 12 pp. 637–638, 1 fig. Sydney, 1947.

A solution of 5 per cent. DDT in kerosene applied at 1 quart per acre, which was extensively used for the control of Anopheline larvae in the North-west Pacific, was considered harmless to fish, but when an emulsified solution was tried instead, fish were killed by concentrations as low as 1 part DDT in 10,000,000. In experimental work in the United States, 1 : 20,000,000 was harmless to fish in six days. When trees surrounding a reservoir were sprayed from the air and some of the spray was washed into the water by rain, giving a DDT concentration of less than 1 : 10,000,000, fish and frogs were killed.

E. J. Wason recorded the finding of hundreds of dead carp (*Carassius*) and crayfish (*Parachaeraps*) along the banks of a reservoir in New South Wales into which enough DDT spray had been allowed to drain on the previous day to give an ultimate concentration of about 1 : 25,000,000. The fish and crayfish were still being affected 24 hours after the pollution. This suggests a practical method of controlling the crayfish.

Shanahan (G. J.) & Morley (F.). **B.H.C. (Benzene Hexachloride) as a Blowfly Dressing.**—*Agric. Gaz. N.S.W.* **58** pt. 12 pp. 660, 672, 2 refs. Sydney, 1947.

After it had been shown that BHC (benzene hexachloride), applied in emulsified xylene, had contact toxicity for blowfly larvae [*R.A.E.*, B **35** 166], wool from living sheep treated with an emulsion containing only 0·3 per cent. benzene hexachloride 6–8 weeks earlier was tested and found to be toxic to old larvae of *Lucilia cuprina*, Wied. An emulsion containing 2 per cent. xylene and 1 per cent. BHC (13 per cent. γ isomer) was tested as a blowfly dressing on ewes on Trangie Experiment Farm in central New South Wales in April 1947, when blowflies were moderately active. It was applied to 18 breech strikes and the surrounding area for 2–3 ins. without removal of the wool, a method that submitted it to a rigorous test and would not be suitable for general use. Two restrikes occurred within 14 days, one away from the original strike and the other on a ewe with a very wrinkled breech. All larvae that came into contact with 2 per cent. xylene emulsion with or without BHC became agitated within a few seconds, and young ones were apparently killed, but the survival rate of the old larvae, which usually left the sheep within ten minutes of treatment, is not known. Survival following immersion for one minute in xylene emulsion containing 1 per cent. BHC was high. During a severe outbreak of flies at Trangie during the following spring, about 200 strikes were treated with various preparations of BHC, and there was practically no restrike. Also, none occurred after 31 head strikes on rams had been treated with an emulsion containing 1 per cent. BHC [*cf.* **36** 57]. It thus appears that such an emulsion will free a strike of larvae and prevent restrike but does not give a satisfactory kill of large larvae. A dressing containing BHC that will kill a high proportion of larvae or prevent them from giving rise to normal adults is being sought.

Kemper (H. E.) & Roberts (I. H.). **Preliminary Tests with DDT for single-treatment Eradication of the Swine Louse,** *Haematopinus suis*. —*J. Amer. vet. med. Ass.* **108** no. 829 pp. 252–254. Chicago, Ill., 1946.

Most sprays and dips used for the control of *Haematopinus suis*, L., a troublesome pest of pigs throughout the year in the south-western United States, require repeated applications to destroy the young lice as they hatch. In the experiments described in this paper, three groups of pigs, all heavily infested with the louse and kept under average farm conditions, were treated once only with sprays or a dip prepared by adding a solution of DDT in benzene to kerosene (for the dip) or kerosene and emulsifiable petroleum oil (for the sprays) and emulsifying with water. Soap was the emulsifier in the dip and weaker spray; the stronger spray was kept from separating by constant agitation. The sprays contained 0·1 and 0·5 per cent. DDT, and each was applied liberally to one sow and her litter of seven. Both destroyed all lice within four hours, but did not destroy all young lice that hatched subsequently. However, only three lice were found eight weeks after treatment with the 0·5 per cent. spray. The dip contained 0·75 per cent. DDT and was tested on 300 heavily infested pigs. It eradicated the lice, killing all motile forms within four hours and continuing effective long enough to destroy all those hatching from the eggs present. The eggs themselves were not killed. There was no injury to the pigs. After the pigs had been dipped, farrowing houses, sheds and pens were sprayed with the dipping fluid.

[Palimpsestov (M. A.).] **Палимпсестов (М. А.). Peculiarities in the Development of Psoroptid Mange Mites.** [*In Russian.*]—*Veterinariya* **24** no. 1 pp. 6–9, 3 figs. Moscow, 1947.

It is generally considered that the females of Sarcoptid mites mature after three months and the males after two, but investigations by the author since

1940 have shown that their development is less simple. His observations were carried out on species of *Psoroptes*, *Chorioptes* and *Otodectes* by infesting their specific hosts and observing the development of the different stages in skin scrapings taken daily. In another series of observations the mites were kept off the host under favourable conditions of temperature and humidity. It was found that the transition from one stage to another was effected not by moulting but by passing through a non-motile pupa-like stage, which the author terms a chrysalid, in which the greater part of the tissues and organs undergo histolysis and the following stage is formed. Each successive stage emerged from the preceding chrysalid by bursting the enveloping integument, just as the larvae do when hatching from the eggs. Mites in the chrysalid stage are protected from unfavourable factors ; like the eggs, they can survive control measures and give rise to reinfestation 3–4 weeks later. During examination of skin scrapings after treatment, the non-motile chrysalid can easily be taken for a dead mite. It is distinguished by its light and shiny colour and rounded body, in which the developing mite is visible as a whitish formation, whereas dead mites are shrivelled and dull greyish-yellow or dark yellow in colour.

The investigations showed that Sarcoptids of both sexes pass through four active and four passive stages, the former being the larva, protonymph, teleonymph and adult, and the latter the egg, the protonymphal chrysalid, the teleonymphal chrysalid and the adult chrysalid. Sexual dimorphism becomes apparent in the larval stage, and the sex of all the subsequent stages is easily distinguished. The adult males pair with the female teleonymphs, but fertilisation of the ovarian cells does not occur until the females become adult, this biological adaptation enabling the adult females to oviposit whenever they find conditions suitable.

[Fortushnuĭ (V. A.).] **Фортушный (В. А.). Treatment of *Psoroptes* Mange in Horses by Means of Sulphur-lime Dust.** [*In Russian.*]—*Veterinariya* **24** no. 1 pp. 9–11, 1 ref. Moscow, 1947.

In experiments in the Ukraine, horses infested to varying degrees by *Psoroptes equi*, Hering, were successfully treated with sulphur-lime dust [*cf. R.A.E.*, B **36** 71]. The dust consisted of 30 parts flowers of sulphur, 20 parts chloride of lime (containing 30–33 per cent. chlorine) and 50 parts chalk, and it was applied to the entire body-surface of the animals and then lightly rubbed into the skin. The temperature of the buildings in which the horses were treated ranged from —2 to —7°C. [28·4–19·4°F.]. The treatment lasted 15–20 minutes and was repeated twice at intervals of three days, the amount of dust used per horse being about 3 lb. for the first application, and 27 oz. for each of the subsequent ones.

The treatment killed all stages of the mite in a few days and prevented reinfestation (or infestation of uninfested horses that were treated) during an observation period of four months. Irritation ceased two days after the first application, but some of the horses, especially the heavily infested ones, developed a slight painful reaction of the skin on the back and rump.

[Sapogov (A. G.).] **Сапогов (А. Г.). The Advantages of controlling the Sheep Botfly by the Method of Hand Collection.** [*In Russian.*]—*Veterinariya* **24** no. 1 p. 41. Moscow, 1947.

Hand collection of sheep bot-flies [*Oestrus ovis*, L.] during their first flight period in May was found in 1945 and 1946 to be a very effective measure of control on a sheep farm in Uzbekistan [*cf. R.A.E.*, B **34** 85 ; **35** 115]. All the buildings were inspected every three days in the morning and again in the

evening for resting bot-flies, and 5,800 were collected and destroyed in 1945 and 4,850 in 1946. As a result, very few bot-flies occurred on the farm during the second flight period, after September.

BOUVIER (G.). **Sur les myiases des mammifères de la Suisse.**—*Mitt. schweiz. ent. Ges.* **20** pt. 4 pp. 291–303, 7 figs., 12 refs. Berne, 1947.

This paper contains information on the 12 species of Oestrids in seven genera that occur or are likely to occur in Switzerland. Keys to the larvae are given for the genera, and for the four species of *Gasterophilus* and the three of *Hypoderma* and to the pupae for the species of *Gasterophilus*, followed by records of the distribution of the 12 species and notes on the bionomics of some of them. Two methods of preserving the larvae are briefly described.

DE CASTRO (M. P.) & PEREIRA (C.). **Alimentação das proteroninfas de** *Boophilus* (*Uroboophilus*) *microplus* **Can., 1888 (Ixodidae) com os restos necróticos da reação tissular do hospedeiro.** [Feeding of Larvae of *B. annulatus microplus* on the necrotic Remains resulting from the Reaction of the Host Tissue.]—*Arq. Inst. biol.* **17** pp. 149-162, 6 pls., 1 fig., 37 refs. São Paulo, 1946. (With a Summary in English.)

In the course of experiments with *Boophilus annulatus microplus*, Can., the authors observed that larvae that fed on the ears of rabbits or on the backs of calves became engorged, but not with blood. The reaction in the host tissues appeared to resemble that described by Trager [*cf. R.A.E.*, B **27** 172], but it occurred in all cases, was not due to previous infestation and did not prevent the larvae from developing normally. The process of feeding of the larvae and the reactions of the skin to it are described, and it is concluded that they fed on the necrotic débris resulting from the destruction of the cells by their saliva and cytolytic substances released from the cells already destroyed.

DE MELLO (M. J.) & PEREIRA (C.). **Determinismo da evasão das larvas de** *Habronema* **sp. da tromba da mosca doméstica.** [Causes determining the Escape of Larvae of *Habronema* sp. from the Proboscis of the House-fly.]—*Arq. Inst. biol.* **17** pp. 259-266, 1 fig., 1 graph, 7 refs. São Paulo, 1946. (With a Summary in English.)

In view of divergent opinions as to the conditions that induce the escape of larvae of *Habronema* from the proboscis of *Musca domestica*, L. [*cf. R.A.E.*, B **11** 57; **13** 130, 131], laboratory experiments were carried out in which infected house-flies were allowed to feed on various liquids at different temperatures. The method and apparatus used are described. The results showed that the larvae escaped only when the temperatures of the air and of the liquids were at least 22 and 23°C. [71·6 and 73·4°F.], respectively. Their escape occurred during the normal feeding of the flies on the blood, plasma or serum of horse or donkey, and also when the flies were obliged to keep the proboscis deeply immersed in warm saline, but it did not occur, even at temperatures of 34–37°C. [93·2-98·6°F.], when the flies fed on the serum, plasma or blood of man, rabbit, guineapig, cow or pig or on solutions of sugar, honey, dextrin, milk or condensed milk, or when they were offered human saliva or the saliva or sweat of horse, on which they did not feed readily. The reason for this is thought to be that when the fly feeds on the blood, serum or plasma of equines, the proboscis is sunk deeply into the liquid and the fly remains motionless for an appreciable time, thus facilitating the escape. Feeding on other liquids is only intermittent and the proboscis may only touch the surface.

Carneiro de Mendonça (F.) & Cerqueira (N. L.). **Insects and other Arthropods captured by the Brazilian Sanitary Service on Landplanes or Seaplanes arriving in Brazil between January 1942 and December 1945.**—*Bol. Ofic. sanit. panamer.* **26** no. 1 pp. 22–30. Washington, D.C., 1947. (With a Summary in Spanish.)

In 1942, the year after *Anopheles gambiae*, Giles, had been eradicated from Brazil [*cf. R.A.E.*, B **32** 159], arrangements were made for spraying all aircraft arriving in that country from Africa, to prevent its re-entry or the entry of any other noxious African insects. The insecticide used was a mixture of pyrethrum, carbon tetrachloride and kerosene, distributed under pressure as a fine spray immediately the door was opened. During the war years, when military traffic greatly complicated the work, operations were continued in association with the U.S. Army authorities, and aerosol bombs were substituted for spraying except at the first opening of the doors. The spraying of military aircraft in flight proved useless as a supplementary measure, since the insecticide escaped through the tail, but in November 1943 the U.S. authorities undertook to carry out sanitation measures on air-fields in Africa from which aircraft left for Brazil. A table is given showing the numbers of Arthropods found in landplanes and flying-boats arriving at the airports of Belem, Fortaleza, Natal and Recife between October 1941 and December 1945, mosquitos being arranged under species and other insects only under families. Some of the mosquitos were evidently of American origin, but 352 examples of *A. gambiae* were taken, and also four of the tsetse fly, *Glossina palpalis*, R.-D. (all in flying-boats). Further tables show the numbers of *A. gambiae* found and the numbers of aircraft from which living or dead Arthropods were secured in the individual months in 1942–45. *A. gambiae* was found in 126 of the 9,229 landplanes and in 16 of the 831 flying-boats that arrived during these four years.

Macchiavello (A.) & Mostajo Patrón (B.). **Reinfección pestosa de puertos peruanos por importación de sacos de yute provenientes de la India.** [Plague-infected Fleas in Bales of Jute Bags imported into Peru from India.]—*Bol. Ofic. sanit. panamer.* **26** no. 3 pp. 225–228, 18 refs. Washington, D.C., 1947. (Also in English, pp. 228–230.)

Sporadic outbreaks of plague in Peru were attributed by Long & Mostajo to the introduction of infected fleas in bales of jute bags from India [*R.A.E.*, B **23** 182–183], and the reappearance of plague in 1944 and 1945 in rural districts of Chiclayo in which such bags had been received led to a further investigation of this possibility. An examination was made of ten bales of jute bags out of a consignment of 400 sent to an estate on which no plague had existed for several years, under circumstances that did not permit local contamination during transit. Seven fleas of the genus *Xenopsylla*, of which five were dead and all were in a fasting condition, were found in the tenth bale. The inoculation of a triturate of these fleas into guineapigs gave, after four serial passages in these animals, a picture of attenuated plague, with extensive glandular involvement and with the presence of plague bacilli in the organs. The attenuation of the virulence of the bacilli is explained by the long time they had lived in fasting fleas [*cf.* **30** 35].

A further 24 fleas were collected from a consignment of sacks unloaded at the port of Huacho. Of these, ten were *X. cheopis*, Roths., eight being alive. Six of these were fed on a guineapig, which died of plague, and the survivor was fed on a second guineapig, with the same result. A third guineapig survived, but the flea when dead was inoculated into another, which became infected.

In view of the difficulty of obtaining adequate penetration of the bales by fumigation, it is suggested that a persistent insecticide, such as DDT, should be applied to the sacking in the course of manufacture.

AMERICANO FREIRE (S.) & FARIA (G. S.). **Criação e alguns dados sôbre a biologia do** *Anopheles* (*N.*) *darlingi*. [Rearing and some Data on the Biology of *A. darlingi*.]—*Rev. brasil. Biol.* **7** no. 1 pp. 57–66, 11 refs. Rio de Janeiro, 1947. (With a Summary in English.)

A detailed description is given of the methods and apparatus used by the authors for rearing *Anopheles darlingi*, Root; the cages were kept at 26–28°C. [78·8–82·4°F.], the optimum for its development in the district (in Minas Gerais) where the initial females were taken, and the relative humidity was 80–90 per cent. The most satisfactory food for the larvae was found to be dried fish, which is rich in vitamin A, and dried bread, ground and mixed in the proportion of 1 : 2, with the addition of a little brewer's yeast. This mixture was allowed to soak in tap water at 26–27°C. [78·8–80·6°F.] for 4–5 days, giving an infusion with a pH of about 7–7·8; its other characteristics are shown in a table. The eggs were placed on water containing a little of the infusion, and a small amount of the supernatant breeding medium was replaced each day by an equal quantity of sediment from the infusion. When the larvae reached the second instar, the sediment was placed on glass plates supported by floating pieces of cork, round and on which the larvae congregated. The addition of Fleischmann's yeast was injurious. In this medium, the egg, larval and pupal stages lasted 1–2, 6 and 2 days, respectively. The cage to which the adults were transferred for pairing was about 4 ft. square and 10 ft. high and consisted mainly of wire gauze, but had the top third and the roof of wood, to provide greater shelter and darkness. The females, which survived for up to 45 days, were allowed to feed on hens and were also given the opportunity to take human blood. The eggs were laid most readily in dishes that had a dark background; the average number deposited per female was 300–400. The adults did not survive at temperatures below 25°C. [77°F.] and, since they showed no preference for human blood, it is thought that their habit of entering houses at nightfall may be due to the falling temperature in the open, examples of which are given. Three generations were reared in the laboratory in 1945 and two, from further field-collected females, in 1946. Towards winter, in both years, the mosquitos ceased to pair and only sterile eggs were laid, although the temperature and humidity were kept constant; this was associated with a diminution in light intensity.

DE OLIVEIRA (S. J.) & MOUSSATCHÉ (I.). **Ação do DDT (Dicloro-difenil-tricloretana) sôbre larvas e pupas de** *Musca domestica* **Linneu.** [The Action of DDT on Larvae and Pupae of *M. domestica*.]—*Rev. brasil. Biol.* **7** no. 1 pp. 67–72, 4 figs., 3 refs. Rio de Janeiro, 1947. (With a Summary in German.)

In each of the tests described, which were carried out in Rio de Janeiro in 1946, a trough was filled with fresh horse manure and left for four days, after which time larvae of *Musca domestica*, L. in all instars were present. The manure, which was about 18 ins. deep, was then sprayed with suspensions of a preparation containing 10 per cent. DDT (Neocid M), diluted to give 1 : 2,000, 1 : 1,000 or 1 : 500 parts DDT in water, at a rate of about 13 pints per sq. yard. The manure was left uncovered after treatment, except on one occasion when rain threatened, and 3–6 days later 600–1,300 puparia collected from it were placed in groups of 100 in tubes containing a little damp earth, and the flies that emerged were counted. The results showed that the percentages of normal, semi-normal and abnormal adults and of puparia from which no emergence occurred were 25·46, 7·23, 12·23 and 55·07 for DDT at 1 : 2,000; 1·1, 0·2, 3 and 95·7 for DDT at 1 : 1,000; and 11·16, 0·16, 1·66 and 87 in one series and 22·5,

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16·8, 15 and 45·7 in another for DDT at 1 : 500. Many of the pupae from which no emergence occurred were abnormal in appearance, and dead larvae in all instars were numerous in the treated manure in the trough.

PEREIRA (C.). **A luta contra as moscas.** [Fly Control.]—*Biológico* **13** no. 2 pp. 25–43, 1 pl., 4 figs. São Paulo, 1947.

An account is given of the life-cycle and habits of *Musca domestica*, L., and of methods of combating this fly in houses and stables that are considered suitable for use in Brazil. These include the protection of food and also of animal feeding stuffs that may serve as breeding media, the treatment of refuse and manure by various methods, and the use of baits, traps and sprays against the adults. Hutchison's trap for the larvae in heaps of manure [*R.A.E.*, B **3** 134] and a modification of it similar to one already noticed [**23** 12] are described in detail, and the uses of DDT in dusts and sprays against flies are reviewed at length.

EKBLOM (T.). **Studien über die Malaria und *Anopheles* in Schweden und Finnland.** [Studies on Malaria and *Anopheles* in Sweden and Finland.]—*Acta path. microbiol. scand.* Suppl. 59, 88 pp., 31 figs., 70 refs. Copenhagen, 1945.

In this detailed study of the history of malaria in Sweden and Finland, where it was widespread in the 19th century, the author discusses the factors that contributed to its appearance and spread in endemic and epidemic forms in those countries, and those that led to its virtual disappearance ; the regression began soon after 1860 in Sweden, but not until well into the present century in Finland. The malaria centres in both countries at different periods are shown on maps, from which it appears that coastal towns were more seriously affected than rural districts. In Sweden, the disease occurred chiefly in the south-east ; its distribution corresponded closely with that of its probable vector, *Anopheles maculipennis*, Mg. [*R.A.E.*, B **20** 70–71], of which vars. *typicus*, *messeae*, Flni., and *atroparvus*, van Thiel, are present, but no correlation has been found between its transmission and any particular variety [*cf.* **27** 26]. In Finland, the disease was limited mostly to the extreme south-western coastal areas, although *A. maculipennis* also occurs much further to the north.

The spread of malaria in northern Europe in the 18th and 19th centuries is attributed mainly to the increase in trade and shipping. Since epidemics in Sweden and Finland often followed epidemics in central and southern Europe after intervals that increased with the distance northwards, it is concluded that the malaria was imported from these areas, and that the parasite concerned was probably *Plasmodium vivax*, which was the species responsible for isolated cases reported in Sweden in 1939.

The regression of malaria in Sweden and Finland is attributed mainly to the increased use of quinine and, to a lesser extent, to improved social and hygienic conditions [*cf.* also **13** 181], and not, as was suggested by Flensburg (1913), to the decline in summer temperatures that has been observed [*cf.* **20** 71] or to a decrease in the number of Anophelines. The theory that the Anopheline vectors have changed to zoophilous habits [**16** 110] is also rejected, since an epidemic occurred in Finland in 1920–22.

NAUCK (E. G.) & others. **Fiat Review of German Science 1939–1946. Tropical Medicine and Parasitology.** [*In German.*] [8+] 253 pp., 7 figs., 2 graphs. [Berlin] Off. milit. Govt. Germ., Field Inf. Agenc. Tech., 1948.

This review of literature published in Germany since the beginning of 1939 and dealing with recent research on tropical diseases of man and animals

comprises four sections; the first, compiled by E. G. Nauck, is on general tropical hygiene, the second, by E. Reichenow and F. Weyer, on parasitology, the third, by Nauck, Reichenow, J. Vogel, A. Westphal & Weyer, on tropical diseases of man, and the fourth, by K. Enigk, on tropical diseases of domestic animals. A bibliography is appended to each section. Only papers shown by the reviews to contain information on Arthropods are noticed below.

The papers in the section on tropical diseases of man include, in addition to several that have already been noticed in this *Review*, one on the distribution of the various species of *Anopheles* in Africa by Weyer (*Dtsch. tropenmed. Z.* **45** 112, 1941); another in which information on the systematic position, distinguishing characters, distribution, breeding and other habits and relation to malaria of *Anopheles gambiae*, Giles, and *A. funestus*, Giles, the most important vectors of malaria in Africa, is given by the same author (*Merkbl. Bernh. Nocht-Inst.* 2. Aufl. Nr. 7, Verlag J. A. Barth, Leipzig, 1940); an illustrated key to the Anophelines of West Africa by E. Ulmann (P. Schöps, Leipzig, 1943); and an account, based on the literature, of the prevalence of malaria in West Africa and its vectors there by W. Hühne (*Dtsch. tropenmed. Z.* **46** 1, 1942). In a contribution to the mosquito fauna of Macedonia and western Thrace, Weyer (*T.c.* 249 and 284) gives an account of observations on the breeding habits of *A. superpictus*, Grassi; owing to the special nature of the breeding places, many of the larvae are killed by heavy rainfall during the main breeding period, and the low incidence of malaria in Macedonia in the autumn of 1941 was probably due to the exceptionally high rainfall during the summer and autumn. W. Eichler (*Op. cit.* **48** 261, 1944) states that in Salonika, an outbreak of *A. superpictus*, which developed when the weather became hot towards the end of June 1942, was followed in due course by an epidemic of malignant tertian malaria [*Plasmodium falciparum*]. In the winter, females of *A. superpictus* were found in shafts in the ground and in sheltered cattle-stalls.

Papers by Weyer (*Flughafen* **10** 8, 1942) and F. Zumpt (*Dtsch. tierärztl. Wschr.* **42** 299, 1944) deal with the control of Anophelines by spraying and dusting from aeroplanes. In 1942, good control of larvae in the swamp areas of the Dnieper and Bug and in the southern Ukraine was obtained with pure calcium-arsenite dust, but spraying was ineffective. In 1943, phenothiazine (thiodiphenylamine) was used with dinitro compounds as carriers, and these compounds proved effective contact poisons against the adults. In other tests described by Zumpt (*Z. hyg. Zool.* **35** 186, 1943) and Zumpt & V. Dinissowa (*Op. cit.* **36** 85, 1944), the best results were obtained with phenothiazine, which, at a dosage of 1·8–2·7 lb. per acre, gave complete mortality of Anopheline larvae within 24 hours without preliminary weeding of the breeding place. The further development of Anopheline control by means of dusts is reviewed by O. Niklas (*Tropenhyg. Schrift.reihe* **10** 24, 1943); phenothiazine is regarded as the best substitute for Paris green. In another paper (*Op. cit.* **12** 12, 1944), Niklas describes the technique of testing poisonous dusts in the laboratory, and M. Sy (*Op. cit.* **10** 40, 1943) describes a method of sieving larvicidal dusts to ascertain their particle size. The size most suitable for the control of Anopheline larvae is about 34 μ, since such particles can be ingested by first-instar larvae. In physical tests, a phenothiazine preparation floated better than Paris green and formed a better dust film; it was more effective as a dust than as a liquid, but its toxicity declined considerably after storage for 12–14 months. In practice, it has proved effective both as a contact and stomach poison.

Several papers contain accounts of successful results obtained against Anophelines with proprietary preparations of the DDT group, including Gesarol (dichlordiphenyltrichlorethane) and Gix (difluorodiphenyltrichlorethane). Sy (*Op. cit.* **11** 25, 1944) found that emulsified solutions of Gesarol

and Gix killed first-instar larvae in 24 hours, and that 20 mg. Gesarol or 30 mg. Gix were required per sq. metre of water surface. K. Mayer (*Ber. 4. Arbeitstag. ber. Ärzte 16–18.5.44 in Hohenlychen*, 161) showed that diluted Gesarol dusts are less effective than Paris green or than Gesarol in emulsified solutions. It appears from papers by other authors, which are reviewed as a group, that Gix and Gesarol are effective against adult Anophelines if used to impregnate tents and fabrics, and that Gix is of value as a spray or in lime-wash to leave a toxic deposit on walls.

Weyer (*Arch. Schiffs- u. Tropenhyg.* **44** 1, 1940) gives a detailed account of malaria epidemics that occurred in the Emden district of northern Germany in 1934–38 and of observations on the frequency, distribution, feeding and overwintering habits of *A. maculipennis*, Mg., var. *atroparvus*, van Thiel. In Germany, malaria is transmitted mainly in July and August and not in September and October as in north Holland [*cf. R.A.E.*, B **24** 283]. The reasons for this difference are stated to be fully discussed. Numerous new cases of benign tertian malaria [*P. vivax*] occurred in Berlin in 1946, following an influx of refugees and released service personnel, and the control measures, which are described by E. Kirchberg & E. Mamlock (*Ärztl. Wschr.* **1** 119, 1946) included applications of larvicides to breeding places of Anophelines. M. Eisentraut (*T.c.* 212) considers that the increase in indigenous malaria in Berlin during the hot summer months is mainly due to an increase in the mosquito population, and recommends controlling the larvae with Paris green or oil and the adults with DDT. Experiments in the control of malaria in the Cherson region of the Crimea in 1942 are described by Zumpt & W. Minning (*Dtsch. tropenmed. Z.* **47** 205, 1943). The breeding places of Anophelines were dusted with pure calcium arsenite and 5 per cent. Paris green, but spraying with oil or with Paris green in oil emulsion was ineffective. A report on ten years' work at the research station for malaria control at Petritsch in Bulgaria is given by K. Drensky (*Z. Hyg.* **122** 550, 1940). The drainage of swamps and dusting with Paris green proved cheap and effective for the control of Anopheline larvae and greatly reduced the spleen and parasite indices and the number of new cases of malaria. *A. maculipennis* var. *atroparvus*, which has a flight range of up to 2½ miles, was the most widely distributed Anopheline, but *A. superpictus*, which increases rapidly in numbers in the hot, dry summers, was also of importance. L. Striberny (*Dtsch. tropenmed. Z.* **47** 624, 1943) describes malaria control in the Bulgarian army in 1942 and 1943 and states that *A. maculipennis* attains its maximum development in July and *A. superpictus* in late summer and autumn, when malaria caused by *P. falciparum* is most prevalent. M. Sliwensky (*T.c.* 613) states that on the Bulgarian coast of the Black Sea and on the coast of the Aegean, *A.m. sacharovi*, Favr (*A.m. elutus*, Edw.) is the most dangerous vector, as man is its favourite host. In Macedonia, *A.m. typicus* is the most important vector, followed by *A. superpictus*.

In a paper by K. Mülhens [*sic*] (*Ber. 4. Arbeitstag. ber. Ärzte 16–18.5.44 in Hohenlychen*, 197), it is stated that as many as 90 per cent. of the German troops in some units in Crete were affected by an epidemic of sandfly fever in 1942–43. The early spring was cool in 1943, and the epidemic did not attain its maximum until July, although the peak is usually reached in June. Cases among the indigenous population were rare. Adults of *Phlebotomus* are in flight between late May and late October, and most numerous in months with an average temperature of 20°C. [68°F.]; the virus requires a temperature of at least 18°C. [64·4°F.] Both the sandflies and the disease are more prevalent in the south and south-east of the island than in the north and west; *P. papatasi*, Scop., occurs at altitudes up to 1,500 ft. Hühne (*Dtsch. tropenmed. Z.* **48** 182, 1944) reports that in North Caucasus, flights of sandflies reach a peak in the second half of July; the species recorded there comprise *P. papatasi*, *P. tobbi*,

Adl. & Thdr., *P. caucasicus*, Marz., *P. kandelakii*, Shchur., *P. sergenti*, Parr., and *P. chinensis*, Newst. They do not occur further north than 45°N. lat.

A paper by Weyer (*Merkbl. med. wichtige Insekten* Nr. 5, 3. Aufl. J. A. Barth, Leipzig, 1943) contains information on the classification, habits, importance and control of *Phlebotomus* spp. Krüpe (*Ber. 4. Arbeitstag ber. Ärzte 16–18.5.44 in Hohenlychen*, 163) in Greece used 1–5 per cent. preparations of Gesarol in water to give deposits of 0·8–8 gm. per sq. metre in houses, barracks and tents. The same amount was used for the impregnation of bed nets. In spraying with Gix, some irritation of the mucous membranes was noticed, but no other ill effects. Substantially higher deposits were needed for tents. Sprayed rooms remained free from *Phlebotomus* for up to four weeks. Similar experiments were made in Sebastopol by H. Wiegers (Diss. 1943), who used a 1–2 per cent. solution for the treatment of sickrooms. The effectiveness of the deposits decreased slowly after two weeks. Gix took effect more rapidly than Gesarol. It appeared that sandflies are affected by deposits with which they do not come in contact; for this reason impregnation of nets is often sufficient to control them. Mayer (*Ber. 4. Arbeitstag. ber. Ärzte 16–18.5.44 in Hohenlychen*, 161) confirmed the action of Gix and Gesarol at a distance; he found that insects in sprayed rooms died without having been in contact with the sprayed surface.

The distribution of urban and rural and of jungle yellow fever in Africa is dealt with in papers by E. Haagen (*Veröff. Marine-Sanitätsw.* **34** 36, 1942 and *Dtsch. med. Wschr.* **67** 13, 1941) and F. O. Höring (*Ber. 3. Arbeitstag. Ost. ber. Fachärzte 24–26.5.43, Berlin*, 112). W. Schüffner (*Tropenhyg. Schriftreihe* **9** 44, 1943) reports that in the laboratory, numerous mosquitos, in addition to *Aëdes aegypti*, L., transmitted yellow fever, but the virus was attenuated when it was transmitted by *A. albopictus*, Skuse. *A. aegypti* is the chief vector of urban and rural yellow fever; at temperatures of 37, 23 and 21°C. [98·6, 73·4 and 69·8°F.], it becomes infective in 4, 11 and 18 days, respectively. The virus decreases in the insect's body in the first week after an infective bloodmeal and then multiplies rapidly. The mosquito remains infective throughout its life.

In the section on diseases of animals, reference is made to a paper by Enigk (*Z. Veterinärk.* **55** 272, 1943) on the infestation of horses by *Gastrophilus*, and to papers by Zumpt (*Dtsch. tropenmed. Z.* **45** 118, 1941) and R. Wetzel (*Dtsch. tierärztl. Wschr.* **49** 123, 1941) on the control of *Glossina*. Other papers, several of which have already been noticed, include one by W. Hohorst (*Vet. med. Nachr. "Behring-Werke"* **4** 61, 1939) giving keys to the adults and eggs of the Mallophaga that infest domestic fowls. F. Schönberg (*Z. Fleisch- u. Milchhyg.* **54** 115, 1944) found that Gix gave excellent control of flies in butchers' shops, food warehouses and cow-sheds, and its effects persisted for at least eight weeks. O. Gebauer (*Z. InfektKr. Haustiere* **56** 207, 1940) observed that newly-hatched larvae of *Hypoderma bovis*, Deg., penetrate the skin of cattle and follow the course of the large nerves to the epidural fatty tissue of the spinal canal. Since larvae of *H. lineatum*, Vill., do not spend more than 51 days under the skin of the back, control of this species must be carried out at intervals of less than this period. Enigk (*Dtsch. tierärztl. Wschr.* **49** 57, 1941) reports the occurrence of summer dermatitis of the cheek among army horses in France in 1940, although in many cases eggs and larvae of *Gastrophilus inermis*, Brauer, which are usually associated with it [*cf.* **29** 34], were not found. The affected horses were heavily infested with eggs of *G. intestinalis*, Deg., and it is thought that some larvae of this species must have gone outwards from the mucous membrane of the lips to their outer surface and thence to the cheeks, causing the lesions in them. It is pointed out that as the larvae involved are not behaving typically [*cf.* **26** 152] the condition does not develop to serious proportions.

Other papers by this author (*Arch. Tierheilk.* **79** 58, 1944 and *Z. Veterinärk.* 1944, 65) contain information on the transmission by ticks of equine piroplasmosis [*cf.* **32** 85–86]. In Central Russia, the period in which the disease can occur is short as *Dermacentor pictus*, Hermann, the only vector, is present on horses only from mid-April until late June [*cf.* **34** 109]. Transmission begins in early spring, and only *Piroplasma caballi* was observed ; it is thought that *Nuttallia equi* does not occur because temperatures in April and May are too low for its development in the tick. In southern Europe, *P. caballi* occurs in spring while *D. marginatus*, Sulz., is present, whereas in summer and autumn *N. equi* is more frequent. Six tick vectors in all stages of development were kept in the open in Berlin during the winter of 1942–43, but only *D. pictus* and *Rhipicephalus bursa*, C. & F., withstood winter conditions in northern Germany. In another paper (*Dtsch. tropenmed. Z.* **48** 88, 1944), Enigk records *D. pictus* and *Hyalomma marginatum*, Koch, as new vectors of *P.* (*Babesia*) *canis* ; the latter, however, is not thought to be an important vector, as the adults are seldom found on dogs. Transmission tests with adults of *Ixodes ricinus*, L., *R. bursa* and *H. dromedarii*, Koch, gave negative results. The species of *Dermacentor* found on mammals in France in winter was always *D. pictus*, which was not previously known to occur in France and is a vector of winter piroplasmosis of dogs there. *D. marginatus*, on the other hand, is not active until early spring. Another paper by the same author (*Monatsh. Vet. Med.* 1947, 75) dealing with the collection of ticks on horses in eastern and southern Europe between March 1943 and July 1944, contains new information on the bionomics of several species. *H. volgense*, P. Sch. & Schlottke, and *H. uralense*, P. Sch. & Schlottke, sometimes behave as one-host ticks, both parasitising large domestic animals in winter. Immature stages of *R. bursa* also overwinter on domestic animals. The only species of *Dermacentor* occurring in central Russia is *D. pictus*. In Macedonia, the most northerly species of *Boophilus*, *B. calcaratus balcanicus*, Minning, occurs chiefly in valleys. *Haemaphysalis cinnabarina punctata*, C. & F., and *I. ricinus* occur only in damp places ; the latter is also found infesting domestic animals in southern Europe during the winter. A paper by A. Heidemann (*Dtsch. tierärztl. Wschr.* **51** 39 and 78, 1943) containing a key to Ixodids, also includes some observations on their bionomics, and one by W. Kratz (*Z. Parasitenk.* **11** 510, 1940) comprises keys to males and females of the genus *Hyalomma*. R. Heymons (*T.c.* 607, 1942) gives an account of work on *Linguatula serrata*, Fröl.

Investigations on the spread of intestinal protozoa by the house-fly [*Musca domestica*, L.] are described in a paper by L. Sieyro (*Dtsch. tropenmed. Z.* **46** 361, 1942). The fly begins to deposit cysts of *Endamoeba histolytica* 1–35 minutes after ingesting them and may continue to void viable cysts in its excreta for 24 hours. It can also transmit cysts of *Giardia* (*Lamblia*) and free-moving intestinal trichomonads, the latter being very resistant to conditions in its gut, although they do not form cysts.

TREMBLEY (H. L.). **Biological Characteristics of Laboratory-reared** *Aëdes atropalpus*.—*J. econ. Ent.* **40** no. 2 pp. 244–250, 1 fig., 1 graph, 18 refs. Menasha, Wis., 1947.

The literature on autogeny in mosquitos (a term commonly used to include deposition of viable eggs by females that have had no blood-meal as well as by females that have not fed at all in the adult stage) is briefly reviewed [*cf. R.A.E.*, B **8** 38 ; **24** 128 ; **25** 94 ; **27** 183 ; **30** 26, etc.] ; it includes a reference made by L. O. Howard, H. G. Dyar & F. Knab in 1912 to the

rearing of two successive generations of *Aëdes atropalpus*, Coq., in captivity from females fed on sugar and water only. An autogenous colony of this species, the adults of which were fed only on dextrose solutions, was established in September 1945 in a Maryland laboratory from an original non-autogenous one [**34** 167] and had successfully completed 26 generations by October 1946. Rearing procedures for the larvae of both colonies were the same, but the original media [**34** 167] were later replaced by distilled water and a diet of ground dog food supplemented by yeast and brain-heart infusion. In general, the food was not carefully measured, and results with this random feeding were successful. Temperatures for larval development ranged from 26 to 30°C. [78·8 to 86°F.] and were generally 27–28°C. [80·6–82·4°F.]. Adults of both colonies, except in controlled experiments, were kept at 21–30°C. [69·8 to 86°F.] and a high relative humidity, and the cages for those of the autogenous colony measured $2 \times 2 \times 2$ ft. or $10 \times 10 \times 15$ inches. For controlled experiments, lantern-globe containers were kept at 28–30°C. [82·4–86°F.] and a relative humidity of about 80 per cent. When pairs of mosquitos were enclosed in lantern globes and in the smaller cages most of the females laid viable eggs, the average number of eggs per female and the percentage hatching being 92·1 and 53·8 in the cages and 95 and 68·6 in the globes. The percentage of females ovipositing or eggs hatching was not increased when the number of males per female was raised to five. Drying eggs for two days before immersion did not materially increase the percentage of hatch, and the data for this paper were drawn from eggs immersed immediately.

Although females of *A. atropalpus* are reputed to bite readily in nature, only a small proportion would bite in the laboratory [*cf.* **34** 167], regardless of the time of day or the intensity or colour of the light, and those only some time after emergence (12–22 days in 68 females observed). Pairing was seen at twilight but not in full daylight or artificial light of any colour or intensity; it is considered to take place customarily in total darkness. Attempts to obtain cross-fertilisation between *A. atropalpus* and *A. aegypti*, L., were unsuccessful. Oviposition took place during darkness, but an alternation of darkness and light was necessary to induce it. The eggs were laid singly, often in patterns, on water or on damp filter papers.

Detailed observations were made on oviposition responses and the developmental periods of mosquitos from the general and the autogenous colonies. Unfed mosquitos of either colony did not live as long as those fed on dextrose solution, but otherwise their reactions were essentially alike. Preoviposition periods varied, but the percentage of viable eggs was usually greater in lots deposited early in the life of a female. The egg-stage lasted from less than 24 hours to 24 days after immersion. The reactions of mosquitos of the two colonies were similar, but the percentage of viable eggs laid was somewhat higher and the larval stage was slightly shorter in the general than in the autogenous colony. Male larvae and pupae developed rather more rapidly than females in both colonies. The percentages of young larvae reaching the adult stage were 87·5 in the general colony and 84·0 in the autogenous one. Only one-third of the females that took blood meals subsequently deposited viable eggs. More than half the females from each colony oviposited without blood-meals and about half of the eggs laid hatched. Blood-fed females that deposited eggs had always previously oviposited autogenously. The time elapsing between the blood-meals and oviposition was 4–14 days. Of 12 females reared from eggs laid after a blood-meal and isolated, each with a male, and not given blood, six deposited eggs. Further experiments on oviposition after blood-meals are planned, but it is tentatively concluded that the normal mode of reproduction is without the aid of blood, or indeed of any food whatsoever. It is pointed out that since this species is autogenous, stenogamous and homodynamic, and the proportion of females does not decrease in successive

generations, it is particularly suitable for laboratory rearing in numbers for experimental purposes.

GRANETT (P.) & SACKTOR (B.). **Testing Tick Repellents and Observations of Phototropic Effects.**—*J. econ. Ent.* **40** no. 2 pp. 259–263, 1 fig., 8 graphs. Menasha, Wis., 1947.

In the course of laboratory tests of repellents against ticks, using laboratory-reared examples of *Amblyomma americanum*, L., it was noticed that these showed marked response to varying intensities of light, and experiments were carried out to test these reactions also. For direct comparison between two repellents or between treated and untreated areas, the chemical to be tested was sprayed on to a filter paper 11 cm. in diameter of which the central portion was protected by a tin disk 6 cm. in diameter, while a sheet of glass completely covered one half of it. In this way, only half the outer ring was sprayed at one time, and the other half left as a control or, if desired, sprayed with another substance after covering the sprayed side with the glass. The materials to be tested were dispersed at a concentration of 5 per cent. in a 1 per cent. solution of sodium oleate in water. Of the 5 cc. liquid applied, about 3 cc. was estimated to fall on the test surface. After 10 minutes had been allowed for the surface to become fairly dry, ticks were placed in the central untreated area and the number crossing into either part of the surrounding area observed. Attractiveness was determined by dividing the difference between crossings to one side and to the other by the total number of crossings, and repellency by dividing the difference between treatment and control crossings by control crossings, both fractions being expressed as percentages. The phototropic response of the ticks was tested by placing two lamps so that one half of the test paper received an illumination of 40 foot candles and the other an illumination of 5–40 foot candles. The widest differences in light intensity produced a difference of only 1°F. between the two halves of the paper, and the possibility of the phototropic effects being influenced by heat was therefore discounted. Attractiveness or repellency in relation to differences in illumination are expressed graphically.

It was observed that *A. americanum*, although crossing indifferently to the two sides of an untreated filter paper when illumination was equal, showed a 20, 60 and 80 per cent. attraction to the lighter side when differences in illumination were 10, 20 and 35 foot candles, respectively, in the case of nymphs, and 14 and 55 per cent. for differences of 15 and 30 foot candles in the case of adults. When the paper was uniformly sprayed with the sodium-oleate solution, the percentage attraction was 55 per cent. with a difference in illumination of 35 foot candles for nymphs and with one of 30 foot candles for adults. When a repellent substance (designated R833) was used in comparison with sodium oleate, its repellency to nymphs was 70 per cent. with equal illumination. When the illumination on the repellent side was reduced, the apparent repellency was increased to 81, 85 and 90 per cent. by differences of 10, 20 and 30 foot candles; but when the illumination on the other side was reduced a difference of 20 foot candles reduced the repellent effect to 5 per cent., and differences of 30 and 35 foot candles resulted in 40 and 45 per cent. attraction to the side treated with the repellent. The repellency of R833 to adults was 49 per cent. under equal lighting conditions, was increased by 10 and 25 per cent. as a result of reductions of 15 and 30 foot candles in lighting on the side treated with it, and was reduced to 10 per cent. and overcome by decreases of 15 and 30 foot candles, respectively, on the other side. It is concluded that, when the treatments on both halves of the test surface were the same, each foot candle difference in light, up to 30, resulted in about 2 per cent. attractiveness toward the lighter side.

GINSBURG (J. M.). **Results from feeding Mosquito Larvae, killed by DDT, to Goldfish.**—*J. econ. Ent.* **40** no. 2 pp. 275–276, 3 refs. Menasha, Wis., 1947.

To ascertain whether fish are likely to be harmed by ingesting the bodies of mosquito larvae poisoned by DDT, laboratory-reared larvae of *Aëdes aegypti*, L., were killed by immersion in water containing alcohol solutions of technical or pure DDT at concentrations sufficient to give complete mortality in 48 hours (0·05–1 parts DDT per million), washed and kept in distilled water at 38°F. About 50 were then added daily for four successive days to the water of each of six test jars containing two goldfish (*Carassius auratus*) 6–9 months old, and 50 living larvae were added to two control jars containing similar fish. In each case, all the larvae were devoured each day. None of the four fish in the controls and only one of the 12 test fish died. The author ascribes the death of this one to natural causes. It is not known whether the larvae killed by the DDT had not taken up enough to poison the fish or whether the DDT had decomposed in their bodies.

PIERPONT (R. L.). **Development of a Terpene Thiocyano Ester (Thanite) as a Fly Spray Concentrate.**—*Bull. Del. agric. Exp. Sta.* no. 253, 58 pp.,14 figs., 8 refs. Newark, Del., 1945.

Early experimental work designed to find substitutes for part or all of the pyrethrum, derris or cubé in fly-sprays, because none of these materials is produced in the United States, showed that some terpene products increased the effectiveness of insecticides in fly-sprays [*cf. R.A.E.*, B **28** 180–182] though they were not themselves insecticidal. Attempts were therefore made to find a substituent or additive group that would react with terpenes and make them toxic. Tables show the results of tests in which several terpene thiocyanates and substituted thiocyanates gave a promising degree of knockdown and kill, in which halogen-substituted esters functioned well as activators of pyrethrum, though they had no toxicity, and in which fenchyl, bornyl and camphene (isobornyl) thiocyanoacetates were the most toxic of a number of specific thiocyanate derivatives of terpenes. Tests were made on *Musca domestica*, L., the first few in accordance with the small-group Peet-Grady procedure [**16** 255] and later ones according to the large-group procedure [**26** 245], and the samples were evaluated by the official method [**27** 23–24]. The high number of moribund flies remaining at the end of 24 hours with many of the new compounds necessitated the making of counts after 48 hours also.

Fenchyl thiocyanoacetate, which was the first product to give outstanding results, had ratings [*cf.* **27** 24] of −30·5 (below B), 34·3 (AA) and 53·5 (AA) at 1, 2·5 and 6 per cent. in deodorised kerosene, respectively, after 48 hours, and at 2·5 per cent. it was also grade AA on the basis of mortality in 24 hours. Subsequent laboratory work was carried out on the basis of developing products that would give AA sprays at a concentration of 2·5 per cent. Original samples had a sulphur odour and produced some irritation, but one was purified to a point at which its physical properties would meet tentative requirements for commercial use. Attempts to correlate the physical and chemical properties of the thiocyanoacetate with toxicity indicated that combined sulphur content had a direct bearing on toxicity. A theoretically pure thiocyanoacetate of fenchyl alcohol would contain about 12 per cent. sulphur. When the sulphur content of the ester was 10 per cent. or more, a 2·5 per cent. solution in deodorised kerosene always gave a grade AA spray, so a tentative specification of a minimum of 10 per cent. sulphur was set.

As fenchyl thiocyanoacetate could not be produced in the quantity required by the insecticide industry from the natural pine oil available, attention was

then directed to bornyl and isobornyl thiocyanoacetates ; the supply of terpenes from which the isobornyl ester can be produced is virtually unlimited. After the three thiocyanoacetates had been found to have similar physical, chemical and insecticidal properties, no attempt was made to differentiate them, and all are referred to as Thanite, the trade-marked name under which they are marketed. It was also found that, in addition to the secondary terpene alcohols, the tertiary terpene alcohols, such as the terpineols and terpin, can be used as raw materials for the preparation of Thanite-type compounds, and Thanite is defined as a blend of thiocyanoacetates of secondary and tertiary terpene alcohols.

It was found possible to produce Thanite on a large scale with physico-chemical and insecticidal properties as satisfactory as those of the laboratory samples.

The knockdown caused by Thanite was slightly slower than that caused by pyrethrum, but more complete. With low concentrations, knockdown in ten minutes decreased slightly as the viscosity of the base oil increased, but with medium (2·5 per cent.) and high concentrations, it was maintained at about 99 per cent. Practically all flies that became moribund (completely incapacitated except for leg movement) after the use of Thanite in a base oil of low viscosity (30–32 seconds Saybolt) died between 24 and 48 hours after treatment. The viscosity of the base oil was found to have little effect on the toxicity of Thanite, until it reached 80–90 seconds. A base oil with a viscosity of 40–60 seconds is recommended for livestock sprays, as one with a lower viscosity may harm the animals and one with too high a viscosity is difficult to apply with existing apparatus. Of various materials tested for packing Thanite and kerosene solutions of Thanite, aluminium and tin were satisfactory ; galvanised iron was slowly corroded, but glass, cork, hard rubber, white-oak barrels, lead and zinc were apparently unaffected. Thanite in deodorised kerosene had no deleterious effect on protective coatings, plastered walls, wall-paper or linoleum, when such surfaces were sprayed in accordance with the usual procedure. Thanite was chemically stable under all normal storage conditions. Its effectiveness was not affected when it was exposed to diffused daylight or direct sunlight for five months in flint-glass bottles, and there was no loss in toxicity when it was stored in Terne Plate (lead-lined) containers for 12 months, and very little when pyrethrum sprays were similarly stored.

Good sprays were produced when Thanite and pyrethrum were combined, though they were not so effective as Thanite alone at the same concentration of total active ingredients. The mortality was attributed to the additive toxicity of the two insecticides ; indications of activation were not pronounced. Losses in toxicity occurred when such sprays were allowed to stand for a month or longer in their final form. Losses occurring when the concentrates were stored were smaller. On the basis of tests made, combinations of Thanite and pyrethrum cannot be recommended. No substantial benefit was found to result from adding other insecticides or pine oil to Thanite sprays.

Extensive toxicity studies in which laboratory animals were given Thanite undiluted or at 5 per cent. in kerosene by mouth, exposed to heavy mists of the 5 per cent. solution or poulticed with undiluted Thanite, or had drops placed in the eyes, indicated that it can be safely used in commercial household and cattle-fly spray formulae. It produced primary irritation, but no progressive local damage, and recovery from ill effects was rapid upon removal from exposure.

Goodall (F. L.), Gorton (T. F.) & Summersgill (J. V.). **DDT and its Textile Applications.**—*J. Soc. Dy. Col.* **62** pp. 189–198, 2 graphs, 20 refs. Bradford, 1946.

The authors describe the preparation and properties of DDT and its characteristics as an insecticide, and give a detailed account of methods of applying

it commercially to textiles, to protect them from insect attack or to prevent them from harbouring undesirable insects, and of estimating the quantity present in treated material. They also discuss its chemical stability, resistance to the processes that textiles may undergo and toxicity to man, and the proprietary forms in which it is available for textile treatment.

Lists are given of insects that attack keratin or cotton and cellulose fibres in textiles, and of injurious insects (notably lice, fleas and *Cimex lectularius*, L.) that may shelter in them. The minimum concentration of DDT effective against *Pediculus humanus humanus*, L. (*P. h. corporis*, Deg.) is almost certainly less than 0·1 per cent. DDT can be applied from solvents, from aqueous suspensions or as a dust in an inert carrier ; it was found that fabrics containing 1–1·5 per cent. DDT applied from solvents generally lose about 40–60 per cent. of the DDT in one wash, depending to some extent on the nature of the washing treatment, whereas if the DDT is applied from an emulsified solution the loss may be slightly greater, possibly because emulsifying agents present on the fabric may tend to re-emulsify the DDT slightly on immersion in water. The removal of the DDT appears to depend more on the detergent power of the solution than on temperature and pH value. If a fabric containing 1–2 per cent. DDT is washed several times, some DDT is removed each time, but when the DDT content is reduced to about 0·1–0·2 per cent., the residue seems to be more resistant to washing. In general, DDT would be removed almost entirely by the solvents used in dry cleaning.

SHANAHAN (G. J.). **Benzene Hexachloride (B.H.C.) for Prevention of Body Strike in Sheep.**—*Agric. Gaz. N.S.W.* **59** pt. 2 p. 98. Sydney, 1948.

Abnormally cool, showery weather during December 1947 and January 1948 rendered sheep in New South Wales particularly susceptible to body strike by blowflies ; it occurred in up to 50 per cent. of the young sheep in the Upper Hunter Valley, and was common even in newly-shorn sheep. Since BHC (benzene hexachloride) had proved of value in preventing poll strike in rams [*R.A.E.*, B **36** 57] and as a blowfly dressing [**36** 153], a test of its effectiveness in preventing body strike was begun on 30th December by treating two groups of 100 18-month-old ewes that had been shorn in July. The sheep in one group were sprayed for three two-minute periods at intervals of one minute with BHC at an initial concentration of 0·5 per cent. in a spray dip in which the top and bottom sprays worked simultaneously ; the fleeces were not completely wetted, although 1·3 gals. spray was removed per sheep. The ewes of the other group were jetted over the shoulders and along the back with 0·32 per cent. BHC applied with a three-jet nozzle at a pressure of 60 lb. per sq. in., which was sufficient to wet the wool satisfactorily. The treated sheep were then run with about 200 untreated ewes for three weeks. During this period, body strike occurred in 19 per cent. of the untreated sheep, none of the sprayed sheep and four of the jetted sheep, but only one jetted sheep was struck on the jetted area. BHC applied by either method is therefore recommended for the treatment of young sheep where conditions favourable for strike persist.

[KARPENKO (S. É.).] **Карпенко (С. З.). Rhinoestrosis of Horses.** [*In Russian.*]—*Veterinariya* **24** no. 3 p. 42. Moscow, 1947.

An outbreak of a fatal disease of horses with symptoms suggestive of encephalomyelitis occurred in the summer of 1946 in the Department of Odessa, but treatments against the latter disease proved ineffective. Over 30 horses were autopsied, and 8–90 larvae of *Rhinoestrus purpureus*, Brauer, were

found in the nasal passages and the ethmoid bone, some of which had penetrated to the olfactory nerves and the soft cerebral membrane. No pathological changes characteristic of encephalomyelitis were found in the internal organs or blood of the animals, and it was concluded that death was due to the infestation, which apparently affected the nervous system and provoked the symptoms observed.

[Tret'yakova (O. N.).] **Третьякова (О. Н.). Treatment of *Psoroptes* Mange in Horses with Powder made from a fused Mixture of Sulphur and Naphthalene.** [*In Russian.*]—*Veterinariya* **24** no. 4 pp. 7–8. Moscow, 1947.

To prepare the dust used in the experiments described, naphthalene was melted in a metal container, an equal amount by weight of flowers of sulphur or refined sulphur was added, and the whole stirred until a uniform melted mass was obtained. After cooling, the fused mixture (of which no chemical analysis was made) was finely ground and passed through a sieve.

In preliminary tests in which batches of 10–20 examples of *Psoroptes equi*, Hering, on watch glasses were dusted and kept at 37°C. [98·6°F.], the mites became motionless in 15 minutes and did not revive, whereas control mites dusted with chalk were still living on the third day.

In experiments with infested horses carried out under various conditions indoors and outdoors and at different seasons of the year, the animals were groomed and the dust was applied to the whole body surface and rubbed in against the hair with a brush or by hand, beginning with the neck and back and finishing with the legs and head, the total amount used per animal, including waste, being 10–14 oz. If the infestation was not very severe, itching ceased in 2–3 hours and no living mites were found in skin scrapings on the following day or during the subsequent week, indicating that the eggs also were killed. The skin healed and hair grew on the affected parts 6–8 days after treatment. In cases of severe general infestation, 2–3 treatments at intervals of 2–3 days were required. When healthy horses were dusted and kept for five days in close contact with infested ones, they remained free from mites.

[Troitzkiĭ (I. A.).] **Троицкий (И. А.). Effect of Humidity on the Course of Mange in Sheep.** [*In Russian.*]—*Veterinariya* **24** no. 4 pp. 10–13, 1 graph. Moscow, 1947.

The investigations described were carried out over a period of two years to elucidate the well-known fact that mange in sheep is favoured by dampness in buildings and by high humidity of the air. Records were made in different months of the year of the moistness of the skin and of the wool on various parts of the body of coarse-woolled sheep by noting the loss in weight on drying. The moistness of the skin increased in September–November and was lowest in summer ; it was less on parts of the body where the skin was thin. In healthy sheep, the percentage moisture of the skin varied from 68·11 to 78·71, with an average of 73·5, whereas in those infested by *Psoroptes ovis*, Hering, and examined in September, it averaged 74·97 in uninjured parts, 75·93 in sites of recent infestation where there was exudate and 71·97 in old foci in which the skin had become hard. The average moisture of the wool (recorded on the neck) increased from 11·46 per cent. in July to 18·27 per cent. in November, and was higher on infested areas.

Seven sheep were artificially infested with *P. ovis* in September, when the weather was damp, and kept in damp quarters until November, when they were transferred to drier ones in which the relative humidity varied from 62·5 per cent. in December to 73 per cent. in the following May. Under these

conditions, the infestation did not progress beyond the point reached in November, the affected parts healed on some sheep and by May living mites were found on only two, and these were lightly infested.

An analysis of data from various districts showed no relation between air temperatures and the development of mange in sheep, but there was a definite correlation with air humidity, infestation being commoner in autumn and decreasing at the end of summer, when the weather is dry. It is important, therefore, that sheep treated against mange in autumn should be kept in dry quarters in which the humidity of the air does not exceed 70 per cent. and ventilation is adequate.

[Lagereva (M. G.).] **Лагерева (М. Г.). Therapeutics and Prophylaxis of Mange in Animals.** [*In Russian.*]—*Veterinariya* **24** no. 4 pp. 13–18, 2 figs., 1 ref. Moscow, 1947.

This is a summary of the results obtained by workers in various parts of the Soviet Union in the treatment of mange in domestic animals.

I. A. Egorov found that 75 per cent. of the affected horses in Kazakstan were infested by *Sarcoptes caballi*, Oudm., 18 per cent. by *Psoroptes equi*, Hering, and 7 per cent. by both mites. As a rule, *Sarcoptes* concentrated on the head, neck and the lower part of the chest and the infestation reached its maximum in February and March. After the usual clipping of the hair on and round the affected parts, washing the skin with warm ash lye and soapy water and drying the animals in special chambers, the treatment adopted consisted in fumigation of the body with sulphur dioxide followed by treatment of the head and neck by three applications, at intervals of 6–7 days, of one or other of six preparations.

The best of these was a mixture of creolin emulsion and lime-sulphur solution, which could be applied throughout the year. It was prepared by boiling 8 oz. freshly slaked lime in 1 gal. water for an hour, gradually adding 1 lb. flowers of sulphur or finely ground and sifted sulphur, boiling the whole for a further hour and allowing to cool and settle for 24 hours. One part of the resulting solution was added to five parts of a 2 per cent. creolin emulsion and the mixture was rubbed into the affected parts with a brush at a temperature of 35–37°C. [95–98·6°F.]. The horses were completely cured in 17–23 days. The next best was a 4–5 per cent. water solution of K soap [which contains dixanthogen (*cf. R.A.E.*, B **31** 227)] at a temperature of 35–38°C. [95–100·4°F.], which was also applicable throughout the year and gave complete cure in 20–30 days, and the third was a mixture of equal parts of waste motor oil and liquid paraffin, which was particularly effective in autumn and winter and eliminated the mites in 21–35 days. The other materials comprised a mixture similar to the first in which sodium hydroxide replaced the lime, a 4–5 per cent. emulsion of creolin, and a tar liniment, all of which were effective but caused dermatitis and thus retarded the cure.

In experiments by I. V. Khudyakov, in the Department of Pinsk, good results were given by a mixture prepared by adding 12 oz. sulphur and 8 oz. sodium hydroxide to 4 pints water, diluting one part of this in 10–12 parts water, and adding about one part creolin. The whole body surface of infested horses was washed with it 3–6 times at intervals of 3–6 days. Another effective preparation consisted of 10 gals. decoction of flax seed, 1 gal. creolin, 10 lb. sulphur, 2·5 gals. formalin and 5 lb. sodium hydroxide, the whole being boiled until the sulphur dissolved. In winter, the treatments were carried out in warm quarters. A simultaneous thorough disinfection of stables, harness and other objects that had been in contact with infested horses was essential.

A. T. Krovetz states that good control of mange in horses was obtained in the Department of Omsk by bringing all infested animals together at certain

points for treatment, cleaning and disinfecting their quarters and closing them for three months, and fumigating the harness. At the concentration points, the horses were first washed with a hot lye (45–48°C. [113–118·4°F.]) prepared by boiling 10 lb. sifted wood ash for 1½–2 hours in 6 gals. water; this was followed by scraping and a wash with a lime-sulphur solution prepared by boiling 10 lb. slaked lime and 12 lb. sulphur in 6 gals. water for one hour and diluting with 30 gals. water, and 6 hours later, the affected areas were smeared with a 10 per cent. creolin ointment. The treatment was repeated three times at intervals of 6–7 days.

Yudin recorded the successful treatment of 18,000 sheep against mange in the region of Altaĭ (south-western Siberia) by shearing the animals and washing the affected parts with diesel fuel oil or a 5 per cent. emulsion of creolin, and then dipping them twice. The interval between dippings was 6–7 days, the sheep were transferred to new pasture or pens after each dipping, and the used pens were disinfected. The dip contained 3 per cent. of the sediment of a tobacco decoction and 1 per cent. formalin. It was warmed to 38–40°C. [100·4–104°F.] and the sheep were immersed for 2 minutes, the head being submerged twice for 2–3 seconds. The temperature was maintained by the addition of hot solution. Lambs were dipped when they were 4–5 months old. There were no symptoms of poisoning, and the wool and skin were not injured, but the solution proved unsuitable for horses, as it coarsened their skin.

At Alma-Ata (south-eastern Kazakstan), Ya. M. Skornyakov controlled mange in sheep by dusting the wool and rubbing the affected part with a mixture of 90 parts sieved ash of the Chenopodiaceous plant sacsaul [*Haloxylon ammodendron*], 8 parts ground naphthalene and 2 parts flowers of sulphur. The treatment was repeated a week later, and the sheep pens cleaned and disinfected.

[Tzaturyan (G. B.).] **Цатурян (Г. Б.). The Application of Hexachlorethane against Lice, Mange and Ringworm.** [*In Russian.*]—*Veterinariya* **24** no. 4 pp. 37–38. Moscow, 1947.

An account is given of experiments in Armenia with hexachlorethane as a dust and as a 20 per cent. solution in vegetable oil; it was dissolved in the oil at 60–70°C. [140–158°F.] and the solution was cooled and shaken before application.

When applied directly to the pig lice and their eggs, the dust and the solution gave complete mortality in five minutes and one minute, respectively, whereas untreated eggs hatched normally. Both solution and dust gave equally good results under farm conditions against lice on calves, sheep and pigs; the dust was rubbed into the skin after the hair or wool had been wetted with water. The lice and their eggs were killed in five minutes, and the animals remained free from infestation during two months of subsequent observation.

Sheep and lambs infested with *Sarcoptes ovis*, Mégn., on the head were successfully treated with the solution which was applied to the affected areas after these had been washed with warm water and soap and the crusts removed. The treatment was repeated four days later and there was no reinfestation during the seven months for which the observations were continued. A double treatment with the solution also cured calves of ringworm.

[Nefed'ev (A. I.).] **Нефедьев (А. И.). Coal-tar Creolin in Salt Solution combined with Fumigation for the Treatment of Mange in Horses.** [*In Russian.*]—*Veterinariya* **24** no. 4 p. 40. Moscow, 1947.

In the course of investigations to find a satisfactory preparation to apply to the heads and necks of horses that are fumigated for the control of mange,

animals heavily infested with *Sarcoptes caballi*, Oudm., or *Psoroptes equi*, Hering, were freed from the mites by copious applications of a mixture consisting of 250 parts common salt, 11 parts sodium hydroxide, 300 parts creolin, and 5,000 parts water heated to 40–50°C. [104–122°F.]. The salt was first dissolved in water, and the sodium hydroxide and creolin then added. The liquid was rubbed in with a brush, care being taken to avoid the eyes, and three applications were made, at intervals of 7–8 days, the first on the day preceding the fumigation and after the hair on the affected areas of the head and neck had been clipped and the horses washed with warm water and ash lye and dried. Itching ceased on the first day, no living mites were found in skin scrapings after any of the applications, and the condition of the horses was good. This treatment later gave good results under farm conditions.

[Vasil'ev (A. V.).] **Васильев (А. В.). The Rôle of Ticks in the Epizootology of Encephalomyelitis of Horses in the southern Transural.** [*In Russian.*]—*Veterinariya* **24** no. 7 pp. 5–9, 1 ref. Moscow, 1947.

In the area south-east of the Ural mountains encephalomyelitis is sometimes common in horses in August and September, and isolated cases occur in late autumn, winter and early spring, probably because a latent infection may become apparent when unfavourable conditions lower resistance. Since Arthropods are known to harbour and transmit viruses that cause equine encephalomyelitis, and the author had obtained negative results in experiments with mosquitos, Tabanids and blood-sucking Muscids in 1933–39, he made tests with *Dermacentor marginatus*, Sulz., in 1940 [*cf.* also *R.A.E.*, B **34** 12–13]. Only adult ticks were used, and liquid for injection was prepared by clipping off the mouth-parts, lightly pressing the cephalothorax and mixing the fluid that exuded with an equal amount of saline. It was injected subcutaneously into rabbits and guineapigs, the amounts injected being 1 ml. and 0·4–0·5 ml., respectively. Since it is chiefly horses in poor condition that contract the disease, the resistance of the laboratory animals was lowered by injection of a haemolytic poison (1 per cent. aqueous solution of phenylhydrazin at the rate of 0·01 ml. per kg. live weight) two days before a test.

In a control experiment with ticks taken on a healthy horse in a district in which the disease had not occurred for several years, no infection was produced in rabbits or guineapigs by three injections of tick fluid at intervals of one month, and repeated injection of phenylhydrazin was not fatal. When ticks from a diseased horse were used, however, two guineapigs and one of two rabbits into which the tick fluid was injected died of the disease, and the cause of death was confirmed by subinoculation of guineapig brain. In a second test, the ticks were taken from the carcass of a horse that had died of encephalomyelitis; two rabbits and one of two guineapigs that received injections died of the disease, and the cause of death was again confirmed by subinoculation. The clinical symptoms produced are described. Fatal infection was also transmitted to a guineapig by rubbing tick fluid into the scarified skin on its back twice at a fortnight's interval, followed, as further trials were not available, by two similar treatments with a suspension of infective rabbit brain; the resistance of the animal had been lowered by three injections of phenylhydrazin, and it died about 48 days after the beginning of the experiment. These results indicated that horses may acquire infection when nibbling one another, if in so doing, ticks are crushed and rubbed into small wounds or sores.

Outbreaks of equine encephalomyelitis occur at intervals of about ten years in the southern Transural, a fact that suggests that the virus persists in alternative hosts, probably rodents.

[Alfeev (N. I.).] **Алфеев (Н. И.). The protracted Cycle of Development of the Tick *Ixodes ricinus* under natural Conditions in the Department of Leningrad.** [*In Russian.*]—*Veterinariya* **24** no. 7 pp. 11–12. Moscow, 1947.

Observations in the Department of Leningrad in 1938–40 showed that the hatching of the eggs of *Ixodes ricinus*, L., and the moulting of the subsequent stages occurred only in autumn. Larvae and nymphs that engorged in the autumn in which they had hatched or moulted, or in the first half of the following summer did not moult to the next stage before the following autumn, development of a single stage thus lasting at least a year, and some nymphs that engorged in spring did not moult until the autumn of the following year. The maturation of the adults similarly lasted at least a year, so that the complete life-cycle in nature requires not less than three calendar years. If, however, ticks that began a given stage in autumn did not feed until the second half of the next summer, they did not complete the stage until the autumn of the following year, so that each stage then required two years. A considerable proportion of ticks in a population of *I. ricinus* is usually subjected to prolonged fasting, and the complete life-cycle from adult to adult may in such cases require up to six years. This does not apply to more southerly areas, such as the Department of Orel, where development after feeding proceeds more rapidly.

[Shik (G. Z.).] **Шик (Г. З.). A Contribution to the Method of laboratory Examination of Material for the Presence of Mange Mites.** [*In Russian.*] —*Veterinariya* **24** no. 7 pp. 18–19. Moscow, 1947.

Skin scrapings of animals are commonly examined for the presence of mange mites by treating a few particles with sodium hydroxide and examining them under a microscope. This treatment, however, kills any mites present, thus rendering diagnosis of an active infestation impossible, and if the mites are not numerous, they may be missed altogether. A better method that has proved satisfactory for several years is described. The scrapings are placed in a petri dish, divided into minute particles and examined first under a weak and then under a strong magnifying glass. The hairs are removed and examined separately. The use of a magnifying glass instead of a microscope gives a larger field of vision and enables the whole of the scrapings to be examined at once. Examination is facilitated by warming the dish, which increases the activity of the mites, but it should not be heated to more than 38–39°C. [about 100–102°F.] or the mites will be killed. They leave the scrapings, but as they do so only gradually, depending on the kind of scraping, its humidity and the species and condition of the mites, examination should be repeated at intervals. Mites have been observed to leave in periods ranging from three minutes to three hours, and, in the case of *Sarcoptes*, even longer.

If no mites are found, the material should be placed in one or more centrifugal tubes, which should be filled to two-thirds of their capacity with a 10 per cent. solution of sodium hydroxide and heated intermittently until the contents boil. The contents should meanwhile be stirred until a smooth uniform mass is obtained. After cooling for 15–20 minutes, the tubes are centrifuged for 10–15 minutes, the fluid poured away and the sediment examined under the microscope. By this method, mites, especially *Sarcoptes*, have frequently been detected in material the previous examination of which gave negative results.

It is important to take scrapings from fresh foci of infestation or from foci that have not been treated for a week. The usual method of transporting

infested material to the laboratory in glass bottles also proved unsuitable, as in most cases the living mites crawled on to the glass, from which it was difficult or impossible to remove them. The most convenient method was to place the material in bags of smooth paper, preferably greaseproof, enclosed in a wooden box.

[Abusalimov (N. S.).] **Абусалимов (Н. С.). Bloodsucking Midges of Azerbaijan.** [*In Russian.*]—*Veterinariya* **24** no. 7 pp. 41–42, 1 fig. Moscow, 1947.

Simuliids are very harmful to buffaloes and other domestic animals in Azerbaijan, and cases of death apparently caused by mass attacks have been reported from various districts. They are particularly injurious in the valley of the Kura, where the species found in May 1946 were *Simulium tarnogradskii*, Rubtzov, and *S. znojkoi*, Rubtzov, the female of which is described. The animals are affected in April, May and sometimes June, and in the absence of treatment, mortality reaches 30–40 per cent., particularly among buffalo cows and calves over six months old. Since the symptoms, which are described, are similar to those of haemorrhagic septicaemia and anthrax, the diagnosis should include bacteriological tests to ascertain that these are not involved.

The measures in local use to protect the animals from attack are to smear the susceptible parts with crude petroleum and to burn fires in the open to drive away the flies by smoke. The author recommends treatment with a 10 per cent. DDT dust or with green oil, which should be applied, at intervals of 5–6 and 10 days, respectively, to the head, neck and under parts of the animals. They do not irritate the skin.

[Lagereva (M. G.).] **Лагерева (М. Г.). Treatment of Skin Diseases in agricultural Animals.** [*In Russian.*]—*Veterinariya* **24** no. 8 pp. 42–44. Moscow, 1947.

This is a survey of the results obtained by veterinary workers in the Soviet Union, chiefly in the treatment of mange.

I. F. Zayanchkovskiĭ in the Department of Stalin (south-eastern Ukraine) obtained good control of mange in horses with lime-sulphur solution prepared by mixing 20 lb. sulphur and 15 lb. quicklime in 10 gals. water, adding 35–40 gals. water and boiling for two hours. The solution retained its acaricidal properties after being kept for over a month. It was heated to 45°C. [113°F.] for use and rubbed into the body surface of the horses for ten minutes, the treatment being repeated 2–3 times at intervals of 5–6 days.

In the Department of Novosibirsk, I. V. Danilenko freed cattle from *Psoroptes [bovis*, Gerl.] by rubbing the affected parts (after grooming) with a liniment prepared by adding 40 lb. finely chopped pine needles from young trees to 6 gals. boiling water, boiling up again and adding 3·2 lb. sodium hydroxide. The mixture was then boiled under a lid for 25–30 minutes and constantly stirred. The liquid was squeezed out and mixed with 1·2 lb. crude cresol. After rubbing it into the skin, a thin layer was applied to the surface of the affected parts, and they were washed and treated again five days later. A third treatment was required in cases of severe infestation.

I. P. Burskiĭ controlled *Psoroptes* on cattle and young pigs by washing the affected parts twice, at an interval of 7 days, with a mixture prepared by boiling together 17 parts 10 per cent. sodium hydroxide and 3 parts sulphur until clear, and adding a 4 or 10 per cent. dilution of this to 4 per cent. creolin at a temperature of 45°C. [113°F.]. All the pigs and about 90 per cent. of the cattle treated with the lower concentration, and all cattle treated with the higher one, were free from mange in 3–4 weeks.

In experiments by P. I. Yankin in the Department of Penza, lice on pigs and calves were killed by a single application of a 2 per cent. solution of anabasine sulphate heated to the body temperature of the animals. In the case of adult cattle, the concentration was increased to 3–4 per cent., and in subsequent treatment of infested pigs a 4–5 per cent. solution was used. A second application was made three days later as a precaution. Since anabasine sulphate is poisonous, only experienced workers should carry out the treatment.

Mange in horses and cattle in a district in Azerbaijan is reported by I. A. Farzaliev & G. N. Nasibov to have been cured by fumigating the body and smearing a liniment over and round the affected areas on the head and neck. The liniment was made by thoroughly mixing 2–3 parts sulphur and 20 parts used motor oil and adding an unstated amount of alcohol, and was used fresh. A single application was sufficient. In tests in which the whole body was treated, there were no ill effects on the animals.

[Tzelishchev (A. A.).] **Целищев (А. А.). Extrazonal Outbreaks of Theileriasis of Cattle in Kazakstan.** [*In Russian.*]—*Veterinariya* **24** no. 9 p. 20. Moscow, 1947.

Bovine piroplasmosis caused by *Theileria* is present in permanent foci in Kazakstan and occurs sporadically in normally uninfected areas from which tick vectors are absent. An outbreak among local cattle occurred in 1945 in a district in the south-east normally free from infection and ticks. *H*[*yalomma*] *detritum*, Schulze, was taken on the sick animals, and it is considered probable that infected nymphs of this tick dropped in spring from cattle that were driven through the area and gave rise to adults that attacked the local cattle in summer and caused the outbreak. The ticks did not survive the winter and the area was free from the disease in 1946. Two outbreaks that occurred in normally uninfected districts in north-eastern Kazakstan in 1946 were confined to recently introduced cattle. The animals were infested by *H. detritum* and were evidently infected on arrival, the disease then being in its incubation period.

Roberts (F. H. S.). **The Occurrence of the Pigeon Fly** (*Pseudolynchia canariensis* **Macq.) in Australia, with a Note on Australian Hippoboscidae.**—*Aust. vet. J.* **21** pp. 150–151, 4 refs. Sydney, 1945.

A brief account is given of the bionomics, importance and control of *Pseudolynchia canariensis*, Macq. (*maura*, Big.) [*cf. R.A.E.*, B **18** 89], which has recently been found on carrier pigeons in Queensland [*cf.* **35** 131]. It has been diversely stated in the literature that the offspring are deposited on the birds, from which they drop into the nest, and that they are deposited in cracks and crevices in sheltered parts of the loft.

Five genera of Hippoboscids comprising 19 species are now known from Australia. A key is given to these genera and to the species that infest domestic birds and mammals (*P. canariensis* on pigeons, *Melophagus ovinus*, L., on sheep, *Hippobosca equina*, L., on horses, and *H. maculata*, Leach, on cattle).

The Prevention of Dengue Fever.—*Bull. U.S. Army med. Dep.* **4** no. 5 pp. 535–539. Washington, D.C., 1945.

Experiments have shown that, in addition to *Aëdes aegypti*, L., and *A. albopictus*, Skuse, *A. scutellaris*, Wlk. [of which *A. hebrideus*, Edw., has recently

been found by A. Stone to be a synonym] may transmit dengue in the Pacific Asiatic area [*cf. R.A.E.*, B **34** 37]. This finding and the development of the use of DDT against mosquitos have necessitated a revision of methods for preventing and controlling the disease. Mosquitos that acquire the infection by feeding on an individual during the first three or four days of fever become infective eight or more days later and remain so throughout life. The breeding places and habits of the three species are described. *A. albopictus* is a semi-domestic mosquito that commonly enters houses and breeds in tree and rock holes near dwellings and occasionally in artificial containers. Both *A. albopictus* and *A. aegypti* bite freely by day as well as by night. Larvae of *A. scutellaris* occur in fairly clean rain-water in coconut shells, tree holes, axils of limbs of mango trees and fallen fronds and also in artificial containers holding small amounts of water. The females apparently enter dwellings only to feed, chiefly in the early morning and late afternoon, and leave soon after engorging. In dull weather, they may bite at any time of day. They rest by day, in cool, damp, shady sites under shrubs and bushes and in untended coconut groves. Their flight range appears to be only about 200 yards.

To prevent outbreaks of dengue, all available means of exterminating the vector population should be used. A survey of the whole area to be protected should be made and all breeding places of the vectors, including the natural breeding places of *A. scutellaris* if this species is present, should be removed or otherwise dealt with. Anything able to hold water for a week or more should be regarded with suspicion, and all unnecessary containers should be removed, even if no larvae are found in them. Artificial containers not holding water for drinking or cooking can be treated with a powder containing 10 per cent. DDT or a solution or emulsified solution containing 5 per cent. ; dosage and intervals between applications should be varied to suit local conditions. Sea water has sometimes been substituted for fresh in fire barrels. Cisterns should be screened and where necessary oiled, and larvivorous fish may be found useful in them. Intensive measures should also be taken against adult mosquitos. Spraying the interior of dwellings with DDT to leave a toxic residue is valuable, and area spraying of vegetation with 5 per cent. DDT in oil is also suggested. Barrier zones may be established by spraying vegetation up to at least 10 yards beyond the boundary of the area to be protected. Up to 5 U.S. gals. per acre should be applied, spraying at waist height with a power or knapsack sprayer. When possible, vegetation should be cleared for about 200 yards round the area. Distribution of sprays of DDT in oil by aircraft is of value during outbreaks of dengue as it immediately reduces the infected mosquito population and also kills larvae if the spray reaches breeding sites. Dispersal of DDT from the air should supplement, not replace, standard measures taken from the ground. Thorough mosquito-proofing of working, sleeping and hospital quarters should be effected wherever possible, and the adequate disinfestation of aircraft and ships is necessary. Individual protection against bites should be practised at all times.

BERTI (A. L.) & MONTESINOS (M.). **Cultivos de arroz en relación con la malaria : el problema en Venezuela.** [Rice-growing in connection with Malaria : the Problem in Venezuela.] –*Cuad. verde Com. ejecut. 3a. Conf. interamer. Agric.* no. 52, 33 pp., 5 figs., 2 fldg. maps, 4 fldg. graphs, 10 refs. Caracas, 1946.

The history of the relation between rice cultivation and malaria is reviewed, and the relative importance of the introduction of large numbers of workers and of the various cultural methods in causing outbreaks of malaria in the neighbourhood of rice fields is discussed. In Venezuela, where rice cultivation

is of considerable importance, *Anopheles albimanus*, Wied., and *A. pseudopunctipennis*, Theo., breed freely in the flooded fields. The former is one of the two chief vectors of malaria in the country [*cf. R.A.E.*, B **36** 54] and the latter is stated to be a suspected vector [but *cf.* also **35** 136].

Two serious outbreaks of the disease due to Anopheline breeding in newly established rice fields recently occurred in the state of Aragua, at La Victoria in 1943 and at Cagua in 1944. The rice-fields at La Victoria were about 1¼ miles from the town, but those at Cagua practically adjoined it. In both cases, continuous flooding was used, and the vector was *A. albimanus*. Maps of both districts and graphs indicating the course of the epidemics are given, and the numbers of Anophelines taken in traps with animal bait are shown in tables and graphs. At La Victoria, the fields were first flooded in May–June ; malaria broke out in the town in June and was at its height in December. No breeding places of *A. albimanus* were found in the area other than in the rice-fields ; the various traps set up showed that the adults could fly for rather more than 1¼ miles from the fields and that control measures against the larva greatly diminished their numbers, particularly in the more distant traps. These measures consisted in the application to the water surface at intervals of six days of 3 per cent. Paris green in ash or road dust, which did not injure the rice. These and other anti-malaria measures were adopted in 1944, and the number of cases was much reduced.

The fields at Cagua were sown at different times and harvested throughout the year, but again the outbreak began in June, suggesting that if the crop were harvested before that month, the danger might be avoided. Other breeding places were present, but only 1 per cent. of the larvae taken were found outside the rice-fields. As no Paris green was available, a mixture of sawdust and kerosene was used against the larvae, but did not give good results.

As a consequence of the outbreaks, legislation was passed prohibiting the cultivation of rice by artificial irrigation near towns except under permit from the Division of Malariology. Permits have been issued subject to the proper levelling and preparation of the land, the use of intermittent drainage (four days flooding and four days draining) and the application of larvicides. Land that cannot be drained dry in four days may not be used for growing rice. The economic aspects of rice cultivation and the costs of epidemics and of control measures are discussed.

Papers noticed by Title only.

Smit (B.). **Fly-traps : their Construction and Operation.**—*Bull. Dep. Agric. S. Afr.* no. 262, 10 pp., 5 figs., 6 refs. Pretoria, 1945. [*Cf. R.A.E.*, B **14** 73.]

Woodruff (N.) & Turner (N.). **The Effect of Particle Size on the Toxicity of DDT Diluents in Water Suspension.**—*J. econ. Ent.* **40** no. 2 pp. 206–211, 3 figs., 8 refs. Menasha, Wis., 1947. [See *R.A.E.*, A **36** 328.]

Ingle (L.). **Toxicity of Chlordane to White Rats.**—*J. econ. Ent.* **40** no. 2 pp. 264–268, 3 refs. Menasha, Wis., 1947. [*Cf. R.A.E.*, A **36** 339.]

Hassall (A.), Doss (M. A.), Segal (D. B.), Hewlett (R. V.) & Ray (D. H.). **Index-catalogue of Medical and Veterinary Zoology. Part 10. Authors : M to Mysh.**—pp. 2967–3481. Washington, D.C., U.S. Dep. Agric., 1948. Price $1.50 (from Supt. Documents). [*Cf. R.A.E.*, B **35** 48.]

PLETZITY (D. F.). **La tique *Dermacentor silvarum*, agent du typhus exanthématique en Sibérie occidentale.**—*C. R. Acad. Sci. URSS* (N.S.) **55** no. 9 pp. 877–878, 1 fig., 9 refs. Moscow, 1947.

Apart from Marseilles fever, which occurs in the Crimea and is transmitted by *Rhipicephalus sanguineus*, Latr. [*R.A.E.*, B **27** 240], the forms of tick-borne spotted fever (atypical typhus) recorded in the Soviet Union all have similar symptoms and etiology. The tick vectors are *Dermacentor nuttalli*, Olen., in south-central Siberia (Krasnoyarsk) [*cf.* **32** 220, 240; **34** 71], *Haemaphysalis concinna*, Koch, in the Maritime Province of the Russian Far East [**34** 113], and *D. silvarum*, Olen., and *H. concinna* in the region of Khabarovsk, also in the Far East. Several similar strains of rickettsiae have also been isolated from *D. marginatus*, Sulz., and *H. cinnabarina punctata*, C. & F. The diversity of the vectors and the local physical and geographical characteristics of the area in which the disease occurs probably account for the slight differences in its epidemiology and clinical development.

Spotted fever also occurs in the region of Kemerovo in western Siberia, and investigations over several years have shown that it is tick-borne. The ticks found were *Ixodes persulcatus*, Schulze, in forest districts, and *D. pictus*, Hermann, and *D. silvarum* in the steppe; *D. silvarum* was abundant and had not previously been recorded from the region. Ticks were collected from vegetation, and suspensions prepared by crushing examples of each species were injected intraperitoneally into guineapigs. Three strains of rickettsiae were isolated, two from adults of *D. silvarum* and one from larvae that hatched from eggs deposited by the females in the laboratory. The infection was maintained through 25 passages in guineapigs, during which it preserved its biological properties unchanged, producing fever and scrotal reaction, accompanied by the presence of rickettsiae. The blood of infected persons produced symptoms in guineapigs identical with those observed in the passages, and it was concluded that *D. silvarum* is the vector of the disease.

In the region of Kemerovo, *D. silvarum* occurs chiefly in undulating grassy steppe used for pasture. Observations in the central part of the region showed that it has one generation a year. Mass infestation of cattle and probably of other animals begins as soon as the snow melts and the weather becomes warm, usually towards the end of April, and continues throughout May. Oviposition begins at the end of May, and the larvae hatch at the end of June. Nymphs appear in July and the first half of August, and adults in the second half of August. The larvae and nymphs infest rodents.

CHARTERS (A. D.). **Tick-typhus in Abyssinia.**—*Trans. R. Soc. trop. Med. Hyg.* **39** no. 4 pp. 335–342, 1 graph, 13 refs. London, 1946.

A small outbreak of a disease resembling typhus occurred in 1943 among white troops stationed at Babile, 17 miles from Harar in Abyssinia, at an altitude of 5,000 feet. There were only four cases and one abortive attack. The Weil-Felix reaction was negative in three out of the four cases; the serum of the fourth agglutinated Proteus OX2 in a dilution of 1 : 400 on the tenth day. Three of the patients were known to have been bitten by ticks, one by a male of *Rhipicephalus pulchellus*, Gerst., and a female of *Amblyomma marmoreum*, Koch, and another by a small brown tick, which may have been *Haemaphysalis leachi*, Aud., a frequent parasite of dogs in the district. In view of these histories of tick-bite, the absence of infestation by lice or fleas and the agglutination of Proteus OX2, the infection was diagnosed as tick-borne typhus, which has not previously been described from Abyssinia. A species of *Trombicula* was common in the area, but the distribution of mite-born typhus [tsutsugamushi disease], the absence of Proteus OXK agglutinins, and the

course of the disease made this an unlikely vector. Prevalent Ixodids taken in the area included *R. pulchellus* and *R. simus*, Koch, on cattle and dogs, *A. variegatum*, F., on cattle, ticks of the group of *A. marmoreum* on tortoise and puff adder, and *H. leachi* on dogs [*cf. R.A.E.*, B **28** 178]. *A. marmoreum* is known to prefer the blood of reptiles to that of mammals; *R. pulchellus* is considered the most likely vector [*cf.* **21** 107; **23** 262]. The symptoms and course of the disease are fully described and compared with those of tick-typhus in Kenya [**19** 40]; none of the cases was very severe. The disease was limited to Europeans, although Africans predominated in the region, and was confined to a period (March–June) coinciding with the rainy season. The site was used as a military camping ground during the one year only.

MacArthur (Sir W. P.). **Habituation of *Pulex irritans* to Animal Host.**—*Trans. R. Soc. trop. Med. Hyg.* **39** no. 4 pp. 343–344, 1 ref. London, 1946.

In view of the successful transmission of plague to rats by *Pulex irritans*, L., and of the general belief that this flea does not readily or for long adapt itself to hosts other than man [*cf. R.A.E.*, B **33** 59–61], the author describes a heavy infestation found on his pet spaniel. Over 100 examples of *P. irritans* were recovered from the dog in the course of a few days, and in spite of repeated mechanical and insecticidal treatment and thorough cleaning of the house, the infestation persisted for more than a year. Although the author was frequently in direct contact with the dog, none of the fleas deserted it for him, but in the few weeks before he was aware of the infestation he had seen occasional examples of *P. irritans*. The dog was treated in an unoccupied room, which the author subsequently entered several times, wearing the minimum of clothing, to test the reactions of any fleas that might have escaped capture. He was attacked viciously about the ankles when he stood upright, and was bitten on any part of the body when he lay on the floor. The other occupants of the house were never to their knowledge attacked.

Use of DDT in Plague Control at Casablanca.—*Bull. U.S. Army med. Dep.* **4** no. 6 p. 633. Washington, D.C., 1945.

When an outbreak of plague occurred in the port district of Casablanca, Morocco, in 1945, the measures adopted for the protection of allied personnel employed in the area included rodent destruction and the application of DDT to kill any fleas that might leave dead rats. A 5 per cent. solution of DDT in kerosene was applied with knapsack sprayers to floors and the lower portions of walls in barracks, offices, warehouses, trucks, and two cargo ships moored to the dock. A 10 per cent. DDT dust was applied to the clothing of personnel required to enter the area. With a rotary blower, dust was applied to places inaccessible to spray, such as under buildings and in rodent burrows. It was not possible to evaluate accurately the part played by DDT, but the plague control programme as a whole was completely effective.

Influence of natural Waters on the Effectiveness of DDT as a Mosquito Larvicide—*Bull. U.S. Army med. Dep.* **4** no. 6 pp. 633–634. Washington, D.C., 1945.

In view of suggestions that the chemical constituents in natural waters might influence the effectiveness of DDT as a mosquito larvicide, laboratory experiments were carried out in Georgia with early fourth-instar larvae of *Anopheles quadrimaculatus*, Say, and third-instar larvae of *Aëdes aegypti*, L., in various test waters. The standard waters used for comparison were distilled

water of which the pH was raised to 8·0 with sodium carbonate for *Anopheles*, and distilled water with a pH of 6·8 for *Aëdes*, and the standard amounts of DDT which killed 70–100 per cent. of the larvae in 48 hours in the standard water, were 0·03 parts per million for the former and 0·0015 p.p.m. for the latter. The test waters consisted of 36 samples of natural waters of widely different chemical composition obtained from various places, and also distilled water containing various amounts of single chemicals commonly found in natural waters. The findings in the laboratory were confirmed by field tests, and it was concluded that no material in solution in natural waters interfered with the rate of kill, provided that the proper amount of DDT for the species in question was applied.

GREAVES (T.). **The Control of Silverfish and the German Cockroach.**—*J. Coun. sci. industr. Res. Aust.* **20** no. 4 pp. 425–433, 3 figs., 7 refs. Melbourne, 1947.

Blattella germanica, L., became abundant in the kitchens of service establishments in the Canberra district during 1939–45. It appears to be more resistant to DDT than other cockroaches [*R.A.E.*, B **35** 91], and a dust containing 5 per cent. p,p′ DDT proved ineffective against it. One containing 10 per cent. was then applied to several large kitchens at a rate of 3–5 lb. each and gave very effective control both of *B. germanica* and silverfish [*cf.* A **36** 364]. It was applied to crevices, especially those in the warmer parts of the room, by means of a knapsack duster with a tube tapering to an outlet hole ¼ in. in diameter fitted to the discharge tube to produce a fine stream of dust at increased pressure. With this attachment, the dust stream could be driven 8–10 yards. Many cockroaches left their shelters during the treatment, and large numbers of dead and dying ones were found on the floor each day for several days after it. One kitchen in which it was possible to obtain information on the persistence of the effects remained virtually free from infestation for over two years. A 5 per cent. benzene-hexachloride dust (0·63 per cent. γ isomer) was used in one kitchen and gave effective control, but it could not be recommended owing to its objectionable and persistent odour.

ALKAN (B.). **Sitoks ilâcı ile zararlı böceklere karşı yapılan denemeler.** [Experiments with Cytox against injurious Insects.]—*Ankara yüks. Ziraat Enst. Dergisi* **9** no. 1 pp. 43–46. Ankara, 1947.

Experiments were carried out in Turkey in 1947 with Cytox, a wettable powder stated to contain 50 per cent. DDT. Some of them are noticed elsewhere [*R.A.E.*, A **36** 352]. A 0·25 per cent. suspension of Cytox in water did not prove very stable; the powder had begun to settle after 13 hours, and most of it had done so after a week. When two bedrooms infested by bed-bugs [*Cimex lectularius*, L.] were sprayed with a 0·25 per cent. suspension, sleepers were not molested for two days, after which attacks recommenced. As no dead bugs had been found, the treatment was repeated at double the strength. Numerous dead bugs were found during the following three days, and no attacks were reported or living bugs seen for 40 days, after which bites were again experienced.

The kitchen and bathroom of a house were sprayed with 0·5 per cent. Cytox against *Blatta orientalis*, L., and *Blattella* (*Phyllodromia*) *germanica*, L., special attention being given to places where the cockroaches were likely to shelter. After 12 hours, 8 dead and 55 paralysed cockroaches were seen, and all the latter were dead 4½ hours later. A second treatment was required after a fortnight, and a third after a further ten days. A second test against *B. germanica* was made in a heavily infested laboratory. A 0·25 per cent. suspension was

liberally applied to the floor, corners, and table drawers and to the backs of cupboards. Numerous dead cockroaches were observed after 15 hours and many more after 40 hours. Few living ones were seen for a while, but infestation was again heavy after three weeks. Treatment with a 0·5 per cent. suspension at intervals of 1–2 weeks is recommended.

Soper (F. L.), Davis (W. A.), Markham (F. S.), Riehl (L. A.) & Buck (P.). **Louse Powder Studies in North Africa (1943).**—*Arch. Inst. Pasteur Algérie* **23** no. 3 pp. 183–223, 1 ref. Algiers, 1945.

Details are given of experiments in Algeria already noticed from a shorter account [*R.A.E.*, B **33** 194] in which dusts gave good control of body lice [*Pediculus humanus humanus*, L.] and were also effective against head lice [*P. h. capitis*, Deg.]. An emulsion containing 5 per cent. by volume of phenyl cellosolve [ethylene glycol monophenyl ether] and 0·1 per cent. of a sodium alkyl sulphate (Tergitol 07) in water [*cf.* **34** 1] was also used against the latter. An account is included of a further test made in a camp for prisoners of war in 1943, in which a powder containing 10 per cent. DDT in pyrophyllite was used on 1,300–1,400 men living in tents, 77 per cent. of whom were found by random sampling to have infested garments. The powder was applied with hand dusters, mostly by unskilled operators and without the removal of clothing; extra clothing and blankets were also treated. After 16 days, the men were again examined, and no lice were found in the garments of any except one who had not been treated.

Parrot (L.), Mornet (J. [*i.e.* P.]) & Cadenat (J.). **Notes sur les phlébotomes. XLVIII. Phlébotomes de l'Afrique occidentale française. 1. Sénégal, Soudan, Niger.**—*Arch. Inst. Pasteur Algérie* **23** no. 3 pp. 232–244, 5 figs., 32 refs. Algiers, 1945.

Parrot (L.) & Martin (R.). **XLIX. Autres phlébotomes du Moyen Congo.**—*T.c.* no. 4 pp. 279–280, 1 fig., 3 refs.

Parrot (L.), Mornet (P.) & Cadenat (J.). **L. Phlébotomes de l'Afrique occidentale française. 2. Guinée, Côte d'Ivoire, Dahomey.**—*T.c.* pp. 281–289, 8 figs., 5 refs.

The literature on *Phlebotomus* in French West Africa is reviewed in the first paper, and notes are given on the morphology, classification and prevalence of sandflies collected by the authors and others between February 1943 and August 1944 in the three northern colonies. They comprised several species and varieties of the subgenus *Sergentomyia* (*Prophlebotomus*) from all three colonies, including a new species from Senegal, and *Phlebotomus* (*Phlebotomus*) *roubaudi*, Newst., from the French Sudan and the Niger Colony. The new species is described as *P. dubius*; it is the one of which two examples were recorded from the Gold Coast and one from Nigeria by O. Theodor and may be identical with *P. antennatus*, Newst., but the identity of the latter is uncertain [*cf. R.A.E.*, B **22** 27–28].

In the third paper, collections made between October 1943 and August 1944 in the southern part of French West Africa are dealt with. All the sandflies found belonged to the subgenus *Sergentomyia* and included one new species from French Guinea and one from the Ivory Coast. Morphological notes are given on some of them.

The second paper contains records of further collections in the Middle Congo [*cf.* **35** 48], made in May and June 1945. They comprise five species of the subgenus *Sergentomyia*, three of which were not in the previous list. Morphological notes are given on these three.

Sergent (Ed.), Donatien (A.) & Parrot (L.). **Expériences de protection des animaux domestiques contre la piqûre des tiques par la poudre insecticide D.D.T.**—*Arch. Inst. Pasteur Algérie* **23** no. 4 pp. 249–259, 1 fig., 3 graphs, 2 refs. Algiers, 1945.

The authors describe experiments in Algeria to test the value of DDT in protecting domestic animals from attack by ticks, and consequently from tick-borne diseases. A 5 per cent. solution of DDT in kerosene was applied by hand to the animals under test. The first experiment was carried out with three short-haired dogs each weighing about 11 lb., enclosed singly in metal cages with wooden gratings for floor, which were placed about half a yard from each other at one end of a tick-proof enclosure. Fasting adults of *Rhipicephalus sanguineus*, Latr., taken in the field were released in the enclosure about 10 ft. from the dogs, and care was taken not to transport ticks in or out with the animals' food or bedding. The dogs were examined daily and the ticks that had attached themselves were counted and left in place until the end of the test. Two of the dogs were treated, one with the DDT solution and one with an equal quantity of kerosene alone, over the whole body, with particular attention to the head, ears, toes and axillae, these being the regions most commonly attacked. The third dog received no treatment. Treatment with a small amount (24 cc. per dog) proved insufficient, and a further test was made with 180 cc. ; 372 ticks were released in the enclosure on the day of treatment, and 453 more 18 days later. During the first part of the test, only one tick attached itself to the dog treated with DDT, on the fifth day, and this failed to survive ; a few dead ones were found in the dog's coat. Ticks were found from the fourth day onwards on the dog treated with kerosene only, with a maximum on the 11th day, but they were less numerous than on the untreated dog, on which they occurred from the first day, with a maximum on the fifth. After the release of the second batch, ticks were found attached to the three dogs after 2, 1 and 1 day, respectively, maximum numbers being found after 14, 7 and 4–5 days. It was concluded that 180 cc. of DDT solution gave protection for up to 18 days, and that kerosene alone gave some protection ; however, both the treated dogs developed severe skin sores during the first fortnight, and the dog treated with DDT lost weight. At the close of the experiment, which lasted 55 days, this dog had regained its original weight, and the others had each gained 2–3 lb.

The remaining experiments were carried out with calves of weights ranging from about 100 to 175 lb., which were treated with 200 cc. of the DDT solution. A treated and an untreated calf were kept in adjoining stalls in a tick-proof enclosure ; they were prevented from coming into direct contact, but ticks could pass from one to the other. In the first test, 52 fasting adults of *Hyalomma mauritanicum*, Senevet, were introduced on the day of treatment ; none was found on the treated calf during the following 16 days, although the control was attacked throughout this period. After 17 days, the same treated calf and a fresh control animal were exposed to 106 ticks infected with *Theileria annulata* (*dispar*). Ticks were found on both animals on the following day, though in far greater number on the control, and both developed the piroplasmosis caused by *T. annulata*, from which the treated calf recovered while the control died on the 12th day. In the last test, 49 ticks were introduced a week after a further calf had been treated, and both it and the untreated control were attacked from the second day, ticks being found on the former for five days and on the latter for 22, and in far greater numbers. It was concluded that DDT would be of no practical value in preventing bovine piroplasmosis, unless applications could be made twice weekly. Both the treated calves showed some ill effects from the treatment, one being more severely affected than the other, although the latter was the

smaller animal. The two men who applied the solution experienced no ill effects though their hands and wrists were soaked with it for about 20 minutes on four occasions.

Ribbands (C. R.). **Anopheline Life-Cycles and Population Fluctuations.**—*Nature* **157** no. 3982 pp. 232–233, 1 ref. London, 1946.

Investigations [in Sierra Leone] showed that the numbers of adults of *Anopheles melas*, Theo., fluctuated regularly with marked peaks usually at intervals of eight days, except when the rhythm was broken by the dominating influence of tides [*cf. R.A.E.*, B **33** 35]. The fluctuations were difficult to explain because investigations by various workers had indicated that the life-cycle of this species and the closely related *A. gambiae*, Giles, must occupy at least ten days. Similar fluctuations at intervals of 12–14 days were found in *A. funestus*, Giles, although the supposed time needed for this species to complete its life-cycle was about 20 days. Subsequent investigations in Assam have shown that a population of *A. minimus*, Theo., undergoes regular fluctuations at intervals of 5 and 10 days and these fluctuations are upset only by occasional very heavy storms, which delay the peak by one or two days if they occur nine days before it is due. Larval investigations, conducted simultaneously, showed that the life-cycle in nature occupies ten days, which is shorter than the hitherto accepted period. It seems likely that the causes of the population fluctuations of *A. melas* and *A. funestus* are the same as those of *A. minimus* and that the life-cycles of these species are shorter than has hitherto been supposed.

Ault (C. N.). **Control of *Boophilus australis* in the Argentine by the Gamma Isomer of Hexachlorocyclohexane ('Gammexane').**—*Nature* **157** no. 3995 pp. 699–700. London, 1946.

Since difficulties, similar to those in other countries [*R.A.E.*, B **35** 130; **36** 21], have been experienced in Argentina during the last ten years in controlling *Boophilus annulatus microplus*, Can. (*australis*, Fuller) on cattle with arsenical dips, tests were carried out with dips containing γ BHC (the γ isomer of benzene hexachloride). When γ BHC was used at concentrations of 1 : 50,000–1 : 17,000 for single dipping or at 1 : 8,000 for double dipping at a fortnightly interval, the numbers of ticks per animal were substantially reduced, and six days after a double dip at 1 : 4,000 the animals were completely free from ticks, but in all cases oviposition by engorged females was not greatly reduced, and nearly all the eggs hatched normally. Double dipping with γ BHC at 1 : 1,700 or 1 : 830 freed the animals from ticks and also affected the engorged females, completely preventing oviposition. When γ BHC was incorporated in a plain arsenical dip (0·2 per cent. AS_2O_3) at 1 : 17,000, the animals were not freed from ticks but oviposition was very incomplete and practically none of the eggs hatched; at 1 : 8,000, all the engorged females detached themselves within 24 hours, no oviposition took place, and the animals were almost completely freed from ticks. Repeated dipping with the arsenical dip alone failed to free the animals from ticks, and although oviposition was incomplete, up to 66 per cent. of the eggs hatched. No adverse effects were observed in the animals treated with BHC.

Jayewickreme (S. H.) & Niles (W. J.). **Successful Feeding Experiments with an Adult Trombiculid Mite (Order Acarina).**—*Nature* **157** no. 4000 p. 878, 5 refs. London, 1946.

While studying the association of *Mansonia uniformis*, Theo., with a water fern of the genus *Salvinia* that is spreading rapidly near Colombo, large

numbers of an adult Trombiculid mite were found crawling about the plants and on the soil of the bank. Several females oviposited in the laboratory, and the larvae that hatched were found to be identical with others collected earlier from the ears of bandicoots (*Bandicota malabarica*) trapped in the neighbourhood. Some of these larvae were reared to the nymphal stage. The mite appears to be *Trombicula acuscutellaris*, Walch. The adults readily attacked egg clusters of *M. uniformis* in the laboratory. Actual imbibition of fluid through the chelicerae into the gut was observed, and complete distension of the abdomen followed a full feed. The mites also fed readily on the ovaries dissected from a gravid female of *Mansonia*, on the ovaries of female Anophelines and on a gravid female of *Anopheles subpictus*, Grassi, that had been killed by stunning. About 50 mites sucked the mosquito dry in about two hours.

Busvine (J. R.). **New synthetic contact Insecticides.**—*Nature* **158** no. 4001 p. 22, 3 refs. London, 1946.

The results are given of laboratory tests against lice [*Pediculus humanus humanus*, L.] and bed-bugs [*Cimex lectularius*, L.] of six synthetic insecticides that have been produced on an industrial scale during recent years in Britain, Germany or the United States. They comprise pure γ benzene hexachloride, pure p,p′ DDT, 2,2-bis(parachlorphenyl)-1,1-dichlorethane (DDD), and the active ingredients of the three German insecticides known as Lauseto, Gix and Lauseto Neu. The active ingredient of Lauseto is prepared by the reaction of benzene with chlorbenzene and chloral and so is probably a mixture of DDT, 2,2-bis-(phenyl)-1,1,1-trichlorethane and 2-phenyl-2-chlorphenyl-1,1,1-trichlorethane. The active constituent of Gix is 2,2-bis(parafluorophenyl)-1,1,1-trichlorethane, and that of Lauseto Neu is chlorphenylchlormethylsulphone, the use of which is limited by its low solubility in refined mineral oils (about 0·25 per cent.). The Lauseto mixture was tested only in oil sprays against lice; its median lethal concentration was 1·2 per cent. The other materials were tested in oil sprays and kaolin dusts against both insects, and the median lethal concentrations (per cent.) of γ benzene hexachloride, DDT, DDD and the active ingredients of Gix and Lauseto Neu, respectively, were 0·016, 0·3, 0·9, 1·4 and 0·1 in oil sprays against lice, 0·051, 0·53, 1·2, 5 and 0·2 in oil sprays against *Cimex*, 0·005, 0·4, 2·4, 1·2 and 0·2 in dusts against lice, and 0·015, 0·5, 1, 3 and 0·6 in dusts against *Cimex*.

Webb (J. E.) & Harbour (H. E.). **Occurrence of Foot Louse of Sheep in the British Isles.**—*Nature* **158** no. 4017 p. 587. London, 1946.

A heavy infestation of *Linognathus pedalis*, Osb., was discovered on the legs of cross-bred Suffolk sheep in a flock in Essex in June 1946. This is the first known occurrence of this louse in the British Isles.

Mattingly (P. F.). **A Technique for feeding Adult Mosquitoes.**—*Nature* **158** no. 4021 p. 751, 1 fig., 9 refs. London, 1946.

During experiments at Yaba, Nigeria, in which females of *Culex fatigans*, Wied., were fed on various blood preparations, only one produced any eggs. It had received one meal of citrated guineapig blood followed by several meals of glucose, and the eggs were few in number and were not laid. *C. fatigans* requires a meal of whole blood taken by biting and can produce many more eggs on a meal of avian blood than on one of mammalian blood. Other species, such as *Aëdes aegypti*, L., can produce viable eggs on defibrinated or citrated blood.

A simple feeding technique is described, which was found useful in work on the transmission of virus, since each mosquito is kept under constant observation

and risk of escape is small. The mosquitos are allowed to emerge in ordinary serum agglutination tubes closed by a plug of cotton-wool or gauze through which the water is poured off. The food is dropped on to a small circle of linen gauze, which is allowed to project in the form of a cap from a feeding tube cut from glass tubing of such diameter that it can be slid easily into the agglutination tube. The success of the method appears to depend mainly on choosing a suitable interval between emergence and feeding. Optimum times probably vary with temperature, but approximate intervals that have been found suitable in West Africa are 72 hours for *C. fatigans*, 60 hours for *A. aegypti*, and 48 for *A. luteocephalus*, Newst. *C. fatigans* was particularly suitable for experimental work, as it is prolific, feeds well and is of such size that its movements in the tube are slowed down though it is not unduly cramped. It has been found possible to infect males of *A. aegypti* with neurotrophic yellow-fever virus administered as a suspension in defibrinated guineapig blood and to recover considerable quantities of virus after incubation for a fortnight.

De Meillon (B.). **Effect on some blood-sucking Arthropods of 'Gammexane' when fed to a Rabbit.**—*Nature* **158** no. 4023 p. 839, 2 refs. London, 1946.

The pure γ isomer of benzene hexachloride was mixed with a solution of agar; when this set, it was cut into portions each containing about 50 mg. γ isomer, and one was given each morning to a rabbit weighing 1,730 gm. Test insects and ticks were then fed through gauze on the ear or shaved side of the rabbit. Toxic effects on the Arthropods became evident on the second day, but the results given are for Arthropods fed after the rabbit had received a total dose of 200–250 mg. γ isomer. Bed-bugs (*Cimex lectularius*, L.) fed fully in all stages and showed signs of paralysis immediately after feeding. Those not tested in the first instar were reared to the desired stage on a normal rabbit. Mortalities within 24 hours were 50–90, 50, 50 and 33 per cent., for nymphs in the first, second, third and fourth instars, respectively. Adults showed signs of paralysis immediately after feeding, but recovered completely within 24 hours. Oviposition was apparently not impaired, though no record was kept of the number of eggs per female. Nymphs that survived their first feed, moulted and were then fed again on the test rabbit showed about the same death-rate as nymphs of the same instar feeding on it for the first time. Females of *Aëdes aegypti*, L., fed fully, showed signs of paralysis within an hour and died within 24 hours. Females that did not feed and males in the same cage were not affected. *Ornithodoros moubata*, Murr., attached immediately but did not feed fully, detaching and showing uncoordinated movements and other signs of distress after a partial meal. Some of the ticks apparently died, others showed increasing signs of poisoning, and none had recovered after ten days.

Kirkwood & Phillips, working with *Saccharomyces cerevisiae*, showed that *i*-inositol inhibits the effect of benzene hexachloride, but intravenous injection of 10 cc. of a 5 per cent. solution of *i*-inositol into a rabbit that had had a total dose of 250 mg. γ isomer did not reduce the toxicity of its blood for *O. moubata* fed a few minutes after the injection [*cf. R.A.E.*, B **33** 131; **36** 99].

Smith (K. M.). **A Textbook of agricultural Entomology.**—2nd edn., 8½ × 5½ ins., xiii+289 pp., frontis., 84 figs., many refs. Cambridge Univ. Press, 1948. Price 18*s*.

This second edition, which is briefly reviewed elsewhere [*R.A.E.*, A **36** 357], includes the information on the bionomics and control of the principal insect pests of farm animals in Great Britain given in the previous one [B **19** 41].

DAVID (W. A. L.). **The Quantity and Distribution of Spray collected by Insects flying through insecticidal Mists.**—*Ann. appl. Biol.* **33** no. 2 pp. 133–141, 1 pl., 2 figs., 12 refs. London, 1946.

A colorimetric method is described for the quantitative measurement of the spray accumulated on insects flying through an insecticidal mist. The spray is dyed with a known quantity of Sudan III, the insects subsequently extracted in odourless kerosene and the extracts compared with a set of standards prepared by diluting the dyed spray solution with odourless kerosene to give a range of 0–1·1 mmg. Sudan III per cc. Since Sudan III is difficult to dissolve completely in odourless kerosene, the sprays were prepared by dissolving it in benzene and adding the solution to an equal volume of odourless kerosene containing the insecticide. They were used for tests on flies (*Musca domestica*, L.) and mosquitos (*Aëdes aegypti*, L.).

In preliminary tests in which the insects flew through a mist of dyed odourless kerosene in which the droplets did not exceed 20*u* in diameter, patches of spray became visible all over both surfaces of the wings and on the halteres, but no spray was visible elsewhere on flies or mosquitos, and separate extraction of the wings and bodies showed that the spray deposit was very much heavier on the wings than elsewhere. Further observations on flies showed that the dye either penetrates directly into the wings and appears within an hour in the Malpighian tubules and rectum or is removed during the cleaning process and absorbed through the legs. Tests were also made with a 5 per cent. solution of gum arabic in water dyed with eosin, since it seemed probable that the oil spray might spread on the insect and not be visible. In these, the droplets were numerous on the wings, lower surface of the abdomen and anterior and posterior legs of the flies, and also occurred on the head, body bristles and halteres. Their distribution on the mosquitos was somewhat different: they were again most numerous on the wings, but although some occurred on the antennae and halteres, there were very few on the abdomen, except at the tip.

In a series of tests with mosquitos in which the method was used to ascertain the quantity of insecticidal spray deposited on them under conditions that had previously been shown to affect mortality, deposits and mortality were both reduced as the interval between formation of the spray mist and exposure of the insects increased (*R.A.E.*, B **34** 157), and were increased with the size of the particles of the mist (**33** 87) and with the flight activity of the insects (**34** 201). In tests with a non-toxic spray mist, the quantities of dye accumulated on the wings of flies and mosquitos were 3–4 and 4–6 times those on the body. In another test 2 and 6 mmg. dye was recovered from the bodies and wings, respectively, of flies that were extracted immediately after treatment, but none was obtained when the extraction was delayed for a day and the flies were able to clean themselves. When the middle and posterior legs were removed, so that the flies could clean their bodies but not their wings, no dye was recovered from the former on extraction a day later, but 3 mmg. was obtained from the latter, indicating that about half the accumulated dye is absorbed into the wing veins: this is later excreted. Absorption by the wings takes place only in living flies, since 6 mmg. dye was recovered from the wings of flies that were killed immediately after exposure, but not extracted for some hours: 1 mmg. was recovered from their bodies. The average mortality among mosquitos and flies that were exposed to a spray mist of DDT in odourless kerosene containing 5 per cent. lubricating oil was reduced from 87 and 82 per cent. respectively, in 18–24 hours to 35 and 36 per cent. when the wings were removed within ten minutes of the treatment. Incomplete observations indicate that insecticides such as DDT may also penetrate slowly directly from the wings.

The method was also used to determine the surface median lethal doses of pyrethrins, DDT and benzene hexachloride. The spray solutions contained 0·1 or 2 per cent. w/v pyrethrins (for mosquitos or flies, respectively) or 0·3 per cent. w/v DDT or benzene hexachloride and 1 per cent. Sudan III in a mixture of equal parts of benzene and odourless kerosene. The maximum median lethal dosages (mg./kg.) of DDT, benzene hexachloride and pyrethrins for males and (in brackets) females were 6 (9), 2 (3) and 31 (38) for *M. domestica*, respectively, and 5·5 (8), 3 (3·5) and 0·5 (1) for *A. aegypti*.

SWEETMAN (H. L.). **The residual Toxicity of DDT. Influence of Moisture and Temperature on the residual Kill of DDT.**—*Soap & sanit. Chem.* **21** no. 12 pp. 141, 143, 145, 147, 149, 171, 25 refs. New York, N.Y., 1945.

Although DDT is chemically fairly stable under the conditions at which it is usually applied, there is some evidence that deposits retain their toxicity longer indoors than when exposed to the full effects of temperature, moisture and light. Laboratory experiments were therefore carried out to evaluate the influence of temperature and moisture on the duration of toxicity. The tests were made against Lepismids [*cf. R.A.E.*, A **36** 378] and *Periplaneta americana*, L., in a basement in which no direct sunlight was received and indirect sunlight and artificial light were relatively low in intensity. The cockroaches were exposed to deposits of a 3 per cent. DDT dust, usually for 24 hours. The dust was sprinkled on to disks of absorbent paper nine inches in diameter so that each sheet carried approximately 0·0265 mg., and the sheets were exposed to temperatures of 5 to 37°C. [41–98·6°F.] and relative humidities of 26–82 per cent. for periods of up to 50 days. For testing, the treated paper was pasted on to the bottom of a pan, which had a glass plate as lid. The cockroaches could climb on the walls of the pans, but spent most of the time on the paper. At the end of the exposure, they were removed to glass jars containing food and water ; a few became paralysed or died during exposure. Preliminary tests showed that large nymphs and adult females were much more resistant than other stages, and young nymphs particularly susceptible. Adult males were used in most of the main experiments.

Detailed results are shown in tables. The toxicity of a treated surface was diminished by insects running over it, so that, in practice, the number of insects coming into contact with a treated surface may influence the duration of effectiveness. Temperatures of 34°C. [93·2°F.] and 37°C., tested only in combination with a high relative humidity (68–80 per cent.) reduced the toxicity of the deposits the most rapidly, disks exposed for 30, 40 and 50 days giving very low kills (usually 20 per cent. or less), although the insects used were in some cases survivors from previous tests ; subsidiary experiments showed that such cockroaches were more susceptible. Temperatures of 27 and 32°C. [80·6 and 89·6°F.], whether associated with high or low relative humidity, reduced mortality very little in 40 days or less, but caused a definite decrease after 50 days. The disks exposed at 5 and 23°C. [41 and 73·4°F.] generally gave high kills for the duration of the tests, irrespective of humidity.

BOTTIMER (L. J.). **Roach Rearing and Testing.**—*Soap & sanit. Chem.* **21** no. 12 pp. 151, 153, 155, 157, 159, 1 fig., 9 refs. New York, N.Y., 1945.

HAZARD (F. O.). **Modifications of the Liquid Roach Method.**—*T.c.* pp. 159, 167.

Accounts are given in these two papers of developments in the technique of rearing German and American cockroaches [*Blattella germanica*, L., and *Periplaneta americana*, L.] and of testing the effectiveness of liquid contact insecticides against them.

In the rearing procedure described in the first paper, the general temperature of the rearing room was 78°F. and little direct sunlight was allowed to enter it. Such work as sorting the cockroaches was done on wooden or metal trays, the insects being prevented from escaping by a thin layer of adhesive round the rims, and in some cases also by moats. The interior of all the containers used was banded with a light mineral oil [*cf.* *R.A.E.*, B **27** 17]. The insects had access to water and pellets of commercial dog food at all times, and paper cups or cones or cylinders of cardboard or other materials were provided as shelters. *B. germanica* was reared by the double-cage method [**28** 54], the young nymphs escaping through a wire screen. They were collected at least once daily and transferred to dated glass jars, which contained a half-inch layer of fine sawdust and had a wire-mesh lid. About 800 could be reared in a jar with a capacity of 1 U.S. gal. until they reached the fourth instar, when they were removed, and those required for testing were transferred to large crystallisation dishes and chilled in a refrigerator. The others were placed in a metal rearing box with a wire-mesh lid and a lining of thick paper to facilitate cleaning, and allowed to develop to the adult stage. They were then chilled and sorted, males being set aside for use in tests and females with egg capsules removed to the brood chamber. The inner section of this was frequently cleared of dead females and débris and thoroughly cleaned and re-greased every few months. The outer box was changed weekly. In the case of *P. americana*, 50–60 adults, comprising one male to every 6–7 females, were kept in a rearing box provided with a crystallisation dish about 5 ins. wide and 2½ ins. deep, about half-filled with finely sifted sawdust. Most of the egg capsules were deposited in this; those in other parts of the box were removed at frequent intervals to prevent their being devoured. The sawdust was sifted through an 8-mesh wire screen at least once a week, and the capsules were removed. Each month's supply was kept in a wide-mouthed bottle 2½ ins. high, two of which were placed in a glass jar, prepared in the usual manner. A bent cardboard strip was placed with one end in the bottle of capsules and the other extending to within about half an inch of the sawdust, to serve as a bridge by which the newly hatched nymphs could escape from the bottle. The strip was kept clear of the sawdust to prevent the older nymphs from travelling back along it. The bottles were transferred to a fresh jar when the first one contained sufficient nymphs; these were provided with shelter and the jar dated. Near the beginning of each month, a bottle containing the previous month's supply of capsules was substituted for the older of the two already in the jar. The insects were sometimes reared to maturity in the jars, with an occasional transfer to clean jars; sometimes the nymphs not used for testing were removed to a rearing box to continue development.

The principal departure from previous spraying methods [*cf.* **27** 17; **30** 71, 194] consisted in the use of a direct spray instead of a settling mist and the calculation of dosage by volume rather than by spraying time, because of differences in the specific gravity of the insecticides. A continuous vertical spray was directed downwards from a DeVilbiss atomiser on to the cockroaches in screen-bottomed cups in an open-topped chamber. The spraying was done at a temperature of 78°F. in a room equipped with a ventilator fan by means of which all excess mist from the sprays was immediately drawn off from the spray chamber. Chilled fourth-instar nymphs or adult males of *Blattella* were used at 20 or 15 per cup, respectively, and nymphs of various ages of *Periplaneta* picked by size (ten examples 12 mm. in length or five larger ones per cup). The cups were 4 ins. wide and 2½ ins. high; the bottom was made of 16-mesh copper screen, and the sides were very smooth and well coated with mineral oil. A cup containing cockroaches was placed in the centre of the spray chamber and sprayed from a vial containing a measured quantity of insecticide. Immediately after spraying, the insects were transferred to a recovery dish, in

which they were kept in the rearing room without food or water for 48 hours. Dead and moribund cockroaches were counted after 24 and 48 hours. Acetone was used to clean the implements, and a small amount was run through the atomiser after each lot was sprayed. One or more new insecticides and the current Official Test Insecticide are each tested on five cups at the same time, and a new insecticide is rated by the difference (plus or minus) between the average percentage mortality for it and that for the O.T.I. A definite indication of the comparative value of a product was usually given by 3–4 series of tests. It is pointed out that this method is not suitable for testing sprays that have a toxic residue. Full descriptions are given of all the apparatus used, both in rearing and spraying.

The cockroach used by Hazard was *Blattella germanica*, and it was reared by a method already noticed [**28** 54], except that adult males were segregated from the stock jars at intervals of seven days, removed to dated jars and kept for a week. This ensured a supply of males known to be 7–14 days old, preliminary tests having shown that these were less susceptible to sprays than younger ones. Other preliminary investigations showed that three inches was the least height of cup wall that the insects were unable to surmount, and that sprays delivered at a pressure of 6 lb. gave more satisfactory kills than those delivered at higher pressures, since particle size varies inversely with pressure and directly with mortality. The method of spraying was substantially the same as Bottimer's, but the test insects were not chilled, reliance being placed on the use of oiled receptacles. Since a very moist atmosphere might affect the accuracy of the tests, the relative humidity of the testing room was kept considerably lower than that of the rearing room, and the cockroaches were kept in the testing room for one hour before being sprayed, to allow for any biological adjustment that might be necessary. Spraying was carried out at 80–84°F., and the results were calculated from two series of five tests for each insecticide made on succeeding days.

Telford (H. S.). **DDT Toxicity.**—*Soap & sanit. Chem.* **21** no. 12 pp. 161, 163, 167, 169, 2 refs. New York, N.Y., 1945.

An account is given of tests noticed in more detail elsewhere [*R.A.E.*, A **36** 379] to determine the toxicity of milk, cream and butter from goats that had received oral doses of DDT [*cf.* B **35** 193]. The whole milk of a goat that received 0·68 gm. DDT per lb. body weight was lethal to white rats from 29 hours to nearly a week after the DDT was administered, and the cream was more toxic to rats than the skimmed milk. Milk from a goat that had received 1 gm. DDT per 8·9 lb. body weight was lethal to house-flies [*Musca domestica*, L.] that fed on it and sprays including butter from goats that had received DDT were much more toxic to house-flies than those prepared from normal goat's butter.

McGowan (E. R.) & Gersdorff (W. A.). **The Effect of Fly Food on Resistance to Insecticides containing DDT or Pyrethrum.**—*Soap & sanit. Chem.* **21** no. 12 pp. 165, 169, 1 ref. New York, N.Y., 1945.

An account is given of experiments made to assess the extent to which the resistance of house-flies [*Musca domestica*, L.] to insecticidal sprays is influenced by the food supplied to the insects before and after treatment, and to determine whether resistance to different insecticides is affected to an equal degree. Pupae from the same culture were placed in groups of about 150 in petri dishes covered with 16-mesh galvanised wire screen, and as soon as the adults began to emerge wads of cotton-wool saturated with one of six foods diluted with

water were placed on pieces of absorbent paper laid on the screen. The food wetted the paper, and the flies fed from the lower surface. The food was renewed twice in 24 hours.

Flies two days old that had fed on the various liquids were sprayed by the turntable method [*cf. R.A.E.*, B **26** 246] with pyrethrum extract or DDT in deodorised kerosene at concentrations of 0·73 mg. pyrethrins or 0·8 mg. DDT per ml. and confined for ten minutes in the settling mist before being transferred to clean recovery cages. Two hours later, a wad saturated with the test food was placed in each cage. The feeding procedure was carried out three times, and the spray tests were made in duplicate, so that the results are the averages of six tests. These are shown in a table. There were considerable variations in the resistance of flies fed on different foods for both insecticides. The foods were fresh skimmed milk and water (1 : 1), with or without the addition of 1 part 40 per cent. formaldehyde to 1,500 parts diluted milk, and spray-dried milk powder, powdered milk, dried whey powder, and granulated sugar, each at 5 per cent. in water, and the percentage mortalities of flies fed on them in 24 hours (averages for the two insecticides) were, respectively, 41, 42, 43, 57, 71 and 77, a difference of 8·4 being significant. The differences between the percentage kills effected by pyrethrum extract and those affected by DDT, which were always greater, ranged from 19 in the case of flies fed on fresh skimmed milk to 37 in that of flies fed on powdered milk. The greater difference occurred mainly at the higher levels of kill.

FINNEGAN (S.). **Acari as Agents transmitting Typhus in India, Australasia and the Far East.**—*Econ. Ser. Brit. Mus.* (*Nat. Hist.*) no. 16, 78 pp., 49 figs. (1 fldg.), refs. London, 1945. Price 1*s.* 6*d.*

Methods of classifying diseases of the typhus group, their etiology and the part played by ticks and mites in transmitting some of them, and measures for preventing infection, are briefly discussed. Those considered in this pamphlet are tsutsugamushi disease (rural typhus), of which the only known vectors belong to the genus *Trombicula*, though species of other Trombiculid genera and some Gamasid and Dermanyssid mites and occasionally even ticks are considered possible ones ; Indian tick-typhus, which is presumably tick-borne and is closely allied to Rocky Mountain spotted fever ; and Australian Q fever, which is transmitted by ticks. Tick typhus is recorded in India and possibly Burma, Q fever in Queensland, and tsutsugamushi disease in India, Ceylon, Malaya, Indo-China, Japan, Formosa, the Pescadores Islands, Sumatra, Java, New Guinea, New Britain and Australia and possibly in the Philippine Islands, Ceram and Amboina. The literature on the occurrence of the diseases in these countries and their known or possible vectors and mammalian reservoirs is reviewed. About half the pamphlet consists of a survey, partly from the literature, of the species of ticks and mites that have been associated with the diseases, including descriptions of each with records of hosts and distribution and keys to families and genera, and to the larvae of the species of *Trombicula* of the Oriental and Austro-Malayan regions. In conclusion, brief notes are given on the examination and mounting of mites.

RUMREICH (A. S.) & KOEPKE (J. A.). **Epidemiological Significance of seasonal Variations in Rodent-Ectoparasite Distribution.**—*Publ. Hlth Rep.* **60** no. 48 pp. 1421-1428, 4 graphs, 18 refs. Washington, D.C., 1945.

Although it has been demonstrated experimentally that a large number of the ectoparasites found on rats in the United States can be infected with endemic typhus, and transmission from animal to animal has been effected

with fleas of several species [*cf. R.A.E.*, B **20** 50; **21** 223; **25** 208; **30** 131; etc.], the mite, *Liponyssus bacoti*, Hirst [**20** 49] and the louse, *Polyplax spinulosa*, Burm. [**20** 130], the incrimination of any as a vector in nature must depend on its presence in sufficient numbers at the time of the outbreak. Studies designed to assess the relative importance, under natural conditions, of the several experimentally demonstrated vectors were accordingly undertaken. Some of the findings of the first three of these field studies, made in 1934 in Jacksonville (Florida), Mobile (Alabama) and Honolulu, are assembled in this report. Ectoparasites were collected from living rats, and fleas from 4,663 rats from Jacksonville, 6,123 from Mobile and 6,382 from Honolulu and lice and mites from 10 per cent. of them were identified. The numbers and percentages of the various species found are shown in a table. The data were examined statistically, the constants used being the same as in a previous report [**35** 10]. In Jacksonville, only in the case of *Xenopsylla cheopis*, Roths., and *Laelaps hawaiiensis*, Ewing, did the biometric constants show significant positive correlation with local temperature. In both instances, the prevalence of the parasite corresponded with the incidence of endemic typhus fever locally and in the surrounding region. Comparisons are made both with typhus cases reported in the same month as that for which the parasite constants were calculated, and in the following month, the latter being an attempt to allow for the incubation period of endemic typhus in man, thought to be about ten days, and the interval between onset of illness and date of report, calculated at about 13 days. In the case of *X. cheopis*, there was statistically significant positive correlation only when the time-lag was used; in that of *L. hawaiiensis* correlation was significant both with and without the time-lag. The populations of the two species were nearly the same.

In Mobile, correlation was significant for *X. cheopis* only with the time-lag, and was practically nil for *L. hawaiiensis*. The numerical ratio between the two species was 1·7 : 1. In Honolulu, there was no correspondence between the prevalence of *X. cheopis* and the incidence of typhus, the correlation between the two being consistently negative, and the correlation for *L. hawaiiensis*, although positive, was not statistically significant. This mite has not yet been proved capable of transmitting the infection. It outnumbered *X. cheopis* by 3·5 : 1. The relationships are shown in all cases in tables and graphs.

It is pointed out that these findings may be influenced by the fact that, owing to scarcity of data on typhus cases at this time, it was necessary to use morbidity reports from areas surpassing in extent those surveyed for parasites, or from another period. In the Jacksonville study, the typhus reports from the States of Florida and Georgia were combined; those from the southern part of Alabama were used for Mobile and, in the case of Honolulu, since no reports were available for 1934, an average was taken of those for 1936–42. The graph of temperature during 1934 was found to correspond closely to that of the average of the seven-year period.

It is tentatively concluded that *X. cheopis* is at least an important vector of typhus at Jacksonville and the chief vector at Mobile, but that there is no evidence that it plays a similar part at Honolulu. Incrimination of *L. hawaiiensis* would depend on demonstration of its infectibility.

HYND (R. S.). **The Construction of Army Huts to limit Infestation by** *Ornithodoros moubata* **(Relapsing Fever Tick).**—*E. Afr. med. J.* **22** no. 10 pp. 337–342, 2 figs. Nairobi, 1945.

The floors, walls and roofs of sleeping huts in certain areas of East Africa Command, notably Kisumu in Kenya and Lusaka in Northern Rhodesia, were

so heavily infested with ticks, mainly *Ornithodoros moubata*, Murr., that some of the huts had to be burned. The incidence of relapsing fever among troops in the same areas was particularly high. To prevent ticks from crawling in, it was suggested that huts be erected on concrete platforms at least six inches higher than ground level, and having a strip of metal inserted into the thickness of the platform and projecting 2–3 ins. all round. The insertion of a further strip into the wall all round the hut 9–12 ins. above floor level and protruding both inside and out was suggested to prevent infestation of walls and roof by introduced ticks. If clothes were not hung on the walls, it should then be possible to confine searching for ticks to the small area of wall below the metal strip. The effectiveness of the device and also the conditions under which *O. moubata* climbs walls were examined by confining ticks in a hardwood box two feet square surmounted by a cage to hold a guineapig. Any tendency of the ticks to climb was not affected by light or darkness. Groups of 18 ticks placed on the floor of the box and left for 14 days made no attempt to climb, but when groups of 80 were used, many climbed to the top of the box in search of crevices, and some entered the cage through holes in the side, whether a guineapig was present or not. When the floor of the box was covered with a layer of finely sifted earth half an inch thick the ticks immediately burrowed into it and made no attempt to climb, irrespective of numbers and conditions. When a metal strip was fitted around the inner sides of the box, at a height of 3 ins. from the base, and 70 ticks were confined in it, they were active and climbed to the strip, but, over a period of 14 days, were unable to surmount it, whether it was new or roughened with a coating of gravel and cement to simulate the effects of weathering. It was concluded that the suggested measures were effective and that floors should be hard, smooth, and preferably of bitumen or concrete.

Díaz Ungría (C.). **Manual de parasitología de los animales domésticos.** [A Manual of Parasitology of domestic Animals.] —[4 +] 523 pp., 324 figs. Madrid, Espasa-Calpe, S. A., 1947. Price 65 *pesetas*.

This book on veterinary parasitology is written with special reference to conditions in Spain and Spanish territories. In addition to chapters on ticks, mange mites and various insects that attack domestic animals and birds and their control, it includes comprehensive sections on protozoa and worms, in which much information is given on Arthropod vectors.

Floch (H.) & Abonnenc (E.). **Sur** *A. nuñez-tovari* **et** *A. pessoai* **en Guyane Française. Table d'identification des** *Nyssorhynchus* **guyanais.**—*Publ. Inst. Pasteur Guyane* no. 126, 5 pp., 3 refs. Cayenne, 1946.

Adults of both sexes of *Anopheles nuñez-tovari*, Gabaldon, were reared from several batches of larvae from different breeding places in French Guiana, and comparison of the stained hypopygium of the male on the basis of which *A. goeldii*, Rozeboom & Gabaldon, was recorded from the Colony [*R.A.E.*, B **34** 57] showed that this also was *A. nuñez-tovari*. Distinctive characters of the larva and pupa of this species are given. Large numbers of larvae of another species taken on the island of Cayenne in past years and females taken in nature have been considered to be *A. albitarsis*, Lynch Arrib. [*cf.* **26** 67] though the larvae, including those that hatched from eggs laid by the females, were atypical in form. Comparison with specimens of *A. albitarsis* from Trinidad showed that the species present in French Guiana is *A. pessoai*, Galvão & Lane [*cf.* **33** 70]. Keys are given to the adults of both sexes and larvae of the species of the subgenus *Nyssorhynchus* occurring in French Guiana and Guadeloupe.

Russell (P. F.), Ramachandra Rao (T.) & Putnam (P.). **An Evaluation of various Measures of *Anopheles* Larva Density.**—*Amer. J. Hyg.* **42** no. 3 pp. 274–298, 9 figs., 9 refs. Lancaster, Pa., 1945.

The following is largely based on the authors' summary. Data on the density of Anopheline larvae were collected from June 1937 until February 1940 in the town and taluk of Pattukkottai, a recently opened rice-growing area in Madras Presidency where the local vector of malaria, *Anopheles culicifacies*, Giles, breeds prolifically [*cf. R.A.E.*, B **31** 219, etc.]. The procedure and materials used are described. The data obtained were analysed by simple and by partial correlation techniques for *A. culicifacies* and for all *Anopheles*. *A. culicifacies* was represented in half of the positive collections, but constituted only 35 per cent. of all larvae taken. Of the larvae of *A. culicifacies* collected, 28 per cent. were from wells.

Good correlation was shown to exist between the logarithms of the monthly catches and either the number of collections made, the minutes spent dipping or the number of square feet searched. The relationship is, therefore, exponential in character. The relationships were all positive, indicating a geometrical increase in larval count accompanying a rise in any of the units used. When regression equations expressing the relationship between larvae taken and both minutes and square feet were computed, the minutes spent dipping were found to be the determining factor. Area covered does not contribute to the number of larvae taken when time is constant. Catches of certain species in wells during 1937 and catches of *A. culicifacies* in borrow pits throughout the period were exceptions to this rule. The precise form of the equation describing the relationship differs for larvae taken from different habitats and also changes from one year to another.

For routine field use, a simple ratio of larvae taken to minutes spent dipping furnishes a practicable measure of density.

Hammon (W. McD.), Reeves (W. C.) & Galindo (P.). **Epidemiologic Studies of Encephalitis in the San Joaquin Valley of California, 1943, with the Isolation of Viruses from Mosquitoes.**—*Amer. J. Hyg.* **42** no. 3 pp. 299–306, 29 refs. Lancaster, Pa., 1945.

Encephalitis and poliomyelitis were both epidemic in Kern County at the southern end of the San Joaquin Valley in the summer of 1943, and there were 203 patients with apparent virus infection of the central nervous system in the County Hospital. Serological tests showed them to include 19 cases of western equine encephalomyelitis and 5 of St. Louis encephalitis, and no differential diagnosis could be made in about 150 other cases without paralysis. Attempts were made to isolate virus from 7,722 mosquitos and 2,430 individuals of *Argas persicus*, Oken. The total numbers of the species from pools of which virus was isolated were 2,158 of *Culex tarsalis*, Coq., 51 of *C. stigmatosoma*, Dyar, and 914 of *Aëdes dorsalis*, Mg.; the negative mosquitos included 3,607 of *C. fatigans*, Wied. (*quinquefasciatus*, auct.). A new virus with neurotropic properties (BFS–91) was isolated from one pool of *A. dorsalis*, and the virus of western equine encephalomyelitis from 28 pools of *C. tarsalis*, one of *C. stigmatosoma* and two of *A. dorsalis*. This was the first time that the virus had been isolated from *C. stigmatosoma*. No species of *Aëdes* had previously been found naturally infected with either the western or eastern virus, though *A. dorsalis* had long been known to be a laboratory vector of the western strain [*R.A.E.*, B **25** 6, etc.]. As it attacks man viciously and is common in many western States, it might be an important vector even if much less frequently infected than *C. tarsalis*. No virus was isolated from a number of

females of *C. tarsalis* taken in January 1944 in areas in which at least eight isolations would have been expected from the infection rates in the previous summer, indicating that the virus does not overwinter in the hibernating mosquitos. The western equine virus remained detectable in infected females kept alive for 24 days at 55°F.

Of fowls that had lived through the summer of 1943 only, 26 and 28 per cent. had neutralising antibodies for the western equine and St. Louis viruses, respectively. Precipitin tests showed that 55 per cent. of all females of *C. tarsalis* caught had fed on birds. It is concluded from these results, which are very similar to those obtained in the Yakima Valley, Washington [**31** 73 74; **33** 80] that *C. tarsalis* is the most important vector of the western equine virus in the San Joaquin Valley of California and that birds, including domestic fowls, are an important source of infection for the mosquitos.

Though no virus was isolated from *Argas persicus*, the western equine virus survived for 13 days in this tick when it was fed on an inoculated fowl.

SEAMAN (E. A.). **An Insect Light Trap for Use with Auto Vehicles in the Field.**—*Mosq. News* **5** no. 3 pp. 79–81, 2 figs. New Brunswick, N.J., 1945.

A description is given of a suction light-trap designed for use in the study of insects, principally mosquitos, when light power of 110 volts is not available. The trap is placed on the hood of a car, is operated by the car's battery, and uses a 32-candlepower 6–8 volt headlight bulb. It is similar in principle to the New Jersey trap [*R.A.E.*, B **31** 195], but differs in that the motor and fan are below the killing jar and insects attracted to the light are caught by a down-draught. A small searchlight reflector with the base 1½ ins. above the bottom of the bulb aids greatly in spreading a brighter light. It can be used for two hours at a time without overtaxing the battery.

EIDE (P. M.). **Outdoor Rearing of *Anopheles quadrimaculatus* Say.**—*Mosq. News* **5** no. 3 pp. 82–85, 2 figs. New Brunswick, N.J., 1945.

An out-door colony of *Anopheles quadrimaculatus*, Say, has been maintained since the spring of 1943 in a creek arising from a spring in Kelly Park, Florida. The water is clear and not sulphurous; it contains small amounts of dissolved solids, the most important being calcium carbonate (46 parts per million). The pH is 7·6, and the temperature is almost constantly 76°F. The lowest winter air temperatures lowered the water temperature only one degree at the rearing boxes. Natural breeding of Anophelines goes on continually in the stream among aquatic vegetation; both *A. quadrimaculatus* and *A. crucians*, Wied., were found, the proportion of the former being greatest near the spring and diminishing gradually farther down the stream.

The colony was confined in wooden boxes 5 ft. long, 1 ft. wide and 1 ft. deep, submerged to a depth of 6–8 ins. Each box had a bottom of 30-mesh copper screen, to allow free exchange of water, and a removable cover of window screen, and was attached to four stakes driven into the stream bed. The original colony was contained in 11 boxes, but the number was progressively increased to 40. At first, the bottom screen was covered with a coat of shellac to protect it from corrosion, but this was found to clog the screen, causing stagnation and lowering of the temperature of the water inside, and the practice was abandoned.

Larvae reared in the laboratory were transported to the boxes in wide-mouthed jugs when they were three days old. The box to be filled was squibbed and replaced, and the water in it was covered with leaves of eelgrass (*Vallisneria americana*), on to which the larvae were poured. Brewer's yeast and finely ground dog food were sprinkled over the surface twice a day, and the larvae fed on the portion that was supported by the eelgrass within their reach.

They also fed below the surface if they could reach the food without losing contact with the surface. Yeast only was used for the first three days, because the dog food sometimes caused a formation of scum that engulfed the small larvae.

During the summer, the pupation began after 6–7 days and was usually over by the 11th day; this agreed well with the larval period in the laboratory. In winter, pupation began after 9–11 days and ended after about 18–22 days. The pupae were collected daily by sinking the eelgrass with a piece of hardware cloth and transferring both larvae and pupae to a pan, for which purpose a scoop made by glueing plastic window screen to a wire frame was found most effective, as it did not retain the smaller larvae. Other larvae were removed with a medicine dropper and returned to the boxes, and the pupae were taken to laboratory cages for emergence of adults.

In November–December 1943, an experiment was carried out to ascertain the maximum productivity of the boxes, in which three groups were stocked with 3,000, 6,000 and 9,000 first-instar larvae per box. The average numbers of larvae and pupae produced per box were 1,260, 2,194 and 2,115, and the maximum numbers from any one box in the respective groups were 2,011, 3,400, and 2,830. The larvae that had not pupated in 20 days were retained in pans floating in the boxes. It was concluded that about 3,000 pupae was the most that could be obtained from one box, regardless of the number of larvae introduced. When 9,000 larvae were used, they did well until the third instar, when lack of food caused considerable mortality. The pupae produced were noticeably smaller, and the larval period was usually lengthened. In the boxes stocked with only 3,000 larvae, there was heavy mortality in the first instar, due apparently to the scum that formed when there was a slight excess of food. The production of pupae in each month of 1944, when 20–30 boxes were in use, is shown in a table. The pupal mortality approximated closely to that of laboratory-reared individuals.

SEAMAN (E. A.). **Ecological Observations and recent Records on Mosquitoes of San Diego and Imperial Counties, California.**—*Mosq. News* **5** no. 3 pp. 89–95, 4 figs., 13 refs. New Brunswick, N.J., 1945.

A list is given of 23 species and varieties of mosquitos taken recently in San Diego and Imperial Counties, California, with notes on their breeding places, local distribution and abundance and the species that breed in association with them. They include *Anopheles maculipennis freeborni*, Aitken, a vector of malaria in southern California [*cf. R.A.E.*, B **30** 154; **33** 155], *Culex fatigans*, Wied. (*quinquefasciatus*, auct.) and *C. erythrothorax*, Dyar, which have been experimentally infected with *Filaria* (*Wuchereria*) *bancrofti* [**35** 139–140], *C. tarsalis*, Coq., which can serve as a reservoir for the viruses of St. Louis and western equine encephalitis and transmit them [**32** 129; **33** 80; **34** 65], *Aëdes vexans*, Mg., *Culiseta incidens*, Thoms., and *C. inornata*, Will., which have transmitted both these viruses in the laboratory, *Culex pipiens*, L., and *C. fatigans*, which have transmitted the St. Louis virus in the laboratory, and *A. dorsalis*, Mg., which has similarly transmitted that of western equine encephalitis [*cf.* **32** 129; **34** 10]. The geographical and climatic characters of the area are described.

YATES (W. W.). **The Effect of Drying on the Viability of *Aëdes* Mosquito Eggs.**—*Mosq. News* **5** no. 3 pp. 98–99, 2 refs. New Brunswick, N.J., 1945.

Aëdes vexans, Mg., and *A. lateralis*, Mg., are common in the lower Columbia river basin, in the north-western United States, and lay their eggs in damp shady places in soil of a type that can absorb and retain moisture well. The

moisture content of five samples from typical breeding areas, collected in the early spring of 1933 and of 1944, was found by drying to average about 40 per cent., although only one appeared to be fully saturated. In April 1933, several samples of soil containing 48 per cent. moisture and large numbers of eggs of *A. vexans* and *A. lateralis* in the proportion of 63 : 37 were stored uncovered in a dry, windowless basement room at a uniform temperature of about 70°F. By April, 1934, the moisture content was reduced to 4 per cent., but numerous larvae, of which 64 per cent. were *A. vexans*, were obtained when samples were flooded. Portions of another soil sample, kept in the laboratory from March to August 1943, when it was dry and dusty, gave rise on flooding to about a quarter as many larvae as did portions flooded before storage. In a final experiment, soil samples collected in March 1944 and then containing 36 per cent. moisture were kept in the basement room and tested at intervals. The successive reductions in moisture and in the viability of the eggs are shown in a table. It was found that by late December, when the moisture content had fallen to 3 per cent., 149 larvae, including both species, hatched on flooding, but a month later only nine hatched, and these were all *A. lateralis*. It was concluded that loss of viability was rapid when the moisture content fell below 3 per cent. and that the eggs of *A. lateralis* were more resistant to drying than those of *A. vexans*.

MADDEN (A. H.), LINDQUIST (A. W.) & KNIPLING (E. F.). **DDT Residues on Vegetation and Ground Litter for Control of adult Salt-marsh Mosquitoes.**—*Mosq. News* **5** no. 3 pp. 100–104, 3 refs. New Brunswick, N.J., 1945.

An account is given of experiments against *Aëdes taeniorhynchus*, Wied., and *A. sollicitans*, Wlk., carried out in Florida in the summer of 1944 to ascertain whether DDT would be effective if applied to the vegetation in jungles for the control of disease-carrying species round military installations [*cf.* also *R.A.E.*, B **36** 116]. Square plots of rather dense jungle were treated by spraying the foliage of the undergrowth and tree trunks up to a height of about five feet. Much of the spray fell on the ground litter. Although the tests were made in the rainy season, no rain fell within 12 hours of an application. The results were evaluated at various points by counting the mosquitos on the front of a man's trousers after exposure for one minute, usually in the early afternoon, at intervals of about a week. All concentrations of DDT are given as weight per volume.

In the first experiment, a solution of 5 per cent. DDT in No. 2 fuel oil was applied to three one-acre plots at 3, 5 and 10 U.S. gals. per acre. The counts, which were very high before the treatments, were reduced by 99, 97 and 95 per cent., respectively, two days after them. The lightest treatment maintained its effectiveness for 17 days and the other two had a considerable effect for 82 days, but none after 102 days; the two higher rates were equally effective. When five acres were sprayed at the rate of 20 U.S. gals. solution per acre, good control was maintained in jungle and in open marsh that formed part of the area until 76 days after treatment, when the natural reduction in mosquitos terminated the test. The spray was laborious to apply with hand equipment at this high rate. When an aqueous emulsion and a fuel-oil solution each containing 5 per cent. DDT were compared by spraying adjoining one-acre plots at the rate of 5 U.S. gals. per acre, the former was found to be slightly more persistent. In another test, half-acre plots were treated with solutions of 5 or 20 per cent. DDT in fuel oil or with 5 per cent. DDT in aqueous emulsion, at 10, 2½ or 5, and 5 U.S. gals. per acre, respectively. There were no significant differences between treatments in the field, but when house-flies (*Musca domestica*, L.) were exposed in the laboratory to random samples of foliage and

ground litter collected in the plots 50 days after treatment, the emulsion gave complete kill in one hour and 5 U.S. gals. 20 per cent. solution in six hours, but the two lighter treatments were found to have lost most of their toxicity.

A 100-foot strip round an untreated half-acre plot was sprayed with 5 per cent. DDT in fuel oil at 10 U.S. gals. per acre, to test its value as a barrier, the mosquitos present in the inner plot at the time of treatment being destroyed with a liquefied-gas pyrethrum aerosol. The percentage reductions in the inner plot and in the barrier itself after 27 days were 57 and 92, respectively, and there was good reduction in the barrier for up to 85 days. This suggested that satisfactory protection would be afforded by this method for a fairly long time against mosquitos with a smaller flight range than *A. taeniorhynchus* and *A. sollicitans*, particularly if the width of the barrier were increased. Two adjoining one-acre plots were then treated with the same spray at 10 U.S. gals. per acre, but it was applied in one to foliage and tree trunks in the manner described, and in the other only to the ground litter, under which the two species of *Aëdes* rest during the daytime. No appreciable difference in effectiveness between the two methods was recorded up to 73 days after treatment, when both plots showed a 75 per cent. reduction and the experiment was terminated. It is concluded that since it appeared unnecessary to treat surfaces other than those on which the species to be controlled is likely to rest, a knowledge of its habits becomes of great importance.

Papers noticed by Title only.

Potter (C.) & Gillham (E. M.). **Effects of atmospheric Environment, before and after Treatment, on the Toxicity to Insects of contact Poisons. I.** [Tests with *Tribolium castaneum*, Hbst., at different temperatures.]—*Ann. appl. Biol.* **33** no. 2 pp. 142–159, 7 figs., 16 refs. London, 1946. [See *R.A.E.*, A **36** 380.]

Finney (D. J.). **The Analysis of a factorial Series of Insecticide Tests.**—*Ann. appl. Biol.* **33** no. 2 pp. 160-165, 10 refs. London, 1946. [See *R.A.E.*, A **36** 381.]

Govaerts (J.) & Leclercq (J.). **Water Exchange between Insects and Air Moisture.**—*Nature* **157** no. 3989 p. 483, 6 refs. London, 1946. [See *R.A.E.*, A **36** 375.]

McIntosh (A. H.). **Relation of Crystal Size and Shape to contact Toxicity of D.D.T. Suspensions.**—*Nature* **158** no. 4012 p. 417, 3 refs. London, 1946. [See *R.A.E.*, A **36** 376.]

Taylor (H.) & Frodsham (J.). **Assay of Toxic Effect of 'Gammexane' on Man and Animals** [tests of benzene hexachloride on rats].—*Nature* **158** no. 4016 p. 558, 3 refs. London, 1946. [See *R.A.E.*, A **36** 378.]

Kanegis (L. A.) & Roepke (M. H.). **DDT: a Review, with special Reference to Veterinary Medicine.**—*J. Amer. vet. med. Ass.* **108** no. 830 pp. 316–321, 32 refs. Chicago, Ill., 1946.

Stage (H. H.). **References to Literature of Interest to Mosquito Control Workers** [chiefly published in 1944 and 1945].—*Mosq. News* **5** no. 3 pp. 113–116. New Brunswick, N.J., 1945. [*cf. R.A.E.*, B **35** 16.]

McCulloch (R. N.) & Waterhouse (D. F.). **Laboratory and Field Tests of Mosquito Repellents.**—*Bull. Coun. sci. industr. Res. Aust.* no. 213, 28 pp., 3 refs. Melbourne, 1947.

The following is almost entirely from the authors' summary of this account of laboratory and field tests of more than 125 substances for use as repellents against mosquitos by troops operating in the south-west Pacific war area. The main species used were *Anopheles farauti*, Lav., *Aëdes aegypti*, L., and *A. vigilax*, Skuse, the common pest mosquito of coastal New South Wales. The time elapsing between treatment and the first bite on treated skin was taken as the preliminary indication of efficiency [*cf. R.A.E.*, B **29** 65 : **34** 25], but, in distinguishing between better repellents, attention was paid to the rate at which subsequent biting occurred. Cage tests were found to be most convenient for selecting the more effective repellents for field testing, but tended to indicate, for good repellents, longer protection than was obtained in field tests. The latter were carried out in New South Wales in coastal tea-tree or mangrove scrubs, mainly against *A. vigilax*, in the autumn and spring of 1942 : in Queensland in mid-summer, when *A. similis*, Theo., predominated ; and in New Guinea at Lalapipi, against various mosquitos, including *Anopheles farauti*.

The most effective repellents, giving nearly complete protection for 45–60 minutes under the most severe conditions (biting frequencies of over 25 per minute on an untreated limb) were dimethyl phthalate, 612 (2-ethylhexanediol-1, 3) [**35** 51], Staway [**29** 65] (which consists of 50 per cent. diethylene glycol monobutyl ether acetate, 15 per cent. diethylene glycol monoethyl ether, 7 per cent. maize oil and 28 per cent. ethyl alcohol) and oils of *Dacrydium franklinii* (Huon pine), *Melaleuca bracteata*, *Zieria smithii* and *Backhousia myrtifolia*. Under similar conditions, Ceylon citronella oil gave protection for no more than 20 minutes.

Oils of Huon pine and *M. bracteata* owe their repellency to their high content of methyl eugenol. They are unsuitable for use because they have a somewhat irritant effect on the skin and cause nausea in some individuals when applied to the face. Oils of *Backhousia* and *Zieria*, which both contain a high proportion of elemicin, are also somewhat irritant and have a pungent smell that renders them less desirable to use than dimethyl phthalate. Staway was excluded from serious consideration when unpublished American reports indicated that it might be unsafe for use on man over long periods. In most tests, 612 gave as good results as dimethyl phthalate, but it has a distinct smell whereas the latter is almost odourless, non-irritant, and comparatively pleasant to use under service conditions.

Dilutions of dimethyl phthalate with ethyl alcohol were less effective than the pure repellent, sometimes considerably so. Methyl ethyl phthalate was almost as effective as dimethyl phthalate and far more so than either diethyl or dibutyl phthalates. When all factors, such as effective protection, absence of objectionable features, and availability, were considered, dimethyl phthalate was by far the most satisfactory repellent tested.

Of a large number of Australian essential oils, other than the four effective ones cited above, the most promising were too irritant to use : many were quite ineffective. Pyrethrum preparations gave consistently poor protection, although a toxic effect on mosquitos biting through them was observed. The four effective essential-oil repellents also had a toxic effect. Indalone [*cf.* **35** 190 ; **36** 46] gave very variable results, but the best were not comparable with those obtained with dimethyl phthalate. The treatment of clothing with the latter substance applied in several times its volume of water from a shaker bottle [*cf.* **35** 96] prevented mosquitos biting through it for two or three days.

The full results of the tests are set out in a table, and an appendix shows the chemical composition of many of the substances tested.

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Floch (H.) & de Lajudie (P.). **Etude des propriétés insecticides de plantes guyanaises.**—*Publ. Inst. Pasteur Guyane* no. 127, 7 pp., 8 refs. Cayenne, 1946.

An account is given of experiments in French Guiana on the toxicity to mosquito larvae of DDT powder and of crushed dried fruit pulp of *Sapindus saponaria*, leaves and stalks of *Baillieria aspera* and seeds of avocado. DDT proved highly toxic to larvae of *Culex* spp. and *Aëdes aegypti*, L., and even more so to those of *Anopheles darlingi*, Root, and *A. aquasalis*, Curry, but the plant poisons, which were not tested against the Anophelines, were relatively ineffective. DDT was more and the plant poisons less effective than the timbo (*Lonchocarpus*) powder previously studied [*R.A.E.*, B **34** 59].

Floch (H.) & de Lajudie (P.). **Sur les propriétés insecticides de la graine de** *Mammea americana* **(abricotier des Antilles).**—*C. R. Acad. Agric. Fr.* **32** no. 14 pp. 611–614, 6 refs. Paris, 1946. **Etude des propriétés insecticides de la graine de** *Mammea americana* **L.**—*Publ. Inst. Pasteur Guyane* no. 128, 4 pp., 8 refs. Cayenne, 1946.

In these two papers, which are almost identical, the results are given of laboratory experiments in French Guiana on the value against mosquito larvae of a powder made of the dried pulp of the seeds of *Mammea americana*. This powder was used because preliminary tests with various parts of the fruit and with the gum exuded by this tree showed that the insecticidal properties resided almost entirely in the pulp of the seeds and were retained when it was dried. When tested at the rate of 100 mg. per 150 cc. water against third-instar larvae, the powder gave complete mortality of *Culex* spp. in about one hour (*C. coronator*, D. & K., being more susceptible than *C. declarator*, D. & K., or *C. fatigans*, Wied.), of *Aëdes aegypti*, L. (*Stegomyia fasciata*, F.) in 24–48 hours, and of *Anopheles darlingi*, Root, *A. triannulatus*, Neiva & Pinto, and *A. aquasalis*, Curry, in an intermediate period. At 10 mg. per 150 cc., all the larvae of *C. coronator* were killed in 48 hours, and of *C. fatigans*, *C. declarator* and *Anopheles* spp. in 72 hours. The percentages of *Aëdes aegypti* killed in 24, 48 and 72 hours were 63, 68 and 73, respectively. Some of the pupae formed died. At 1 mg. per 150 cc., 66 and 70 per cent. of larvae of *C. coronator* died in 48 and 96 hours, respectively, and the mortality among other species of *Culex* was only slightly inferior ; 25 per cent. of *Anopheles* larvae and 5–20 per cent. of those of *Aëdes aegypti* died in 96 hours. These results were little inferior to those obtained with a timbo (*Lonchocarpus*) powder containing 5 per cent. rotenone [*R.A.E.*, B **34** 59].

In tests against pupae of *C. coronator*, concentrations of 10 or 100 mg. in 100 cc. water appeared ineffective until the moment of emergence, when kills of 91 and 93 per cent., respectively, were observed. At the same concentrations, the timbo powder killed 40 and 50 per cent., respectively.

When exposed to light and air, water containing the *Mammea* powder retained its toxicity to mosquito larvae for 3–4 days. The powder was about half as lethal to larvivorous fish (*Poecilia vivipara*) as the timbo powder [*loc. cit.*].

Parker (W. L.) & Beacher (J. H.). **Toxaphene, a chlorinated Hydrocarbon with insecticidal Properties.**—*Bull. Del. agric. Exp. Sta.* no. 264, 27 pp., 4 figs., 6 refs. Newark, Del., 1947.

Toxaphene, previously known as 3956 [*R.A.E.*, B **36** 8], is a chlorinated camphene with the approximate empirical formula $C_{10}H_{10}Cl_8$. Like DDT, it has one labile chlorine atom and should not be used with strongly alkaline materials.

Technical Toxaphene is a waxy solid that contains 67–69 per cent. chlorine, melts in the range of 65–90°C. and is highly soluble in common organic solvents. The solid can be stored in cardboard cartons or paper bags and solutions in suitable cans [*cf.* A **36** 395] for at least a year without deterioration.

Experiments with Toxaphene against various insects [*cf.* A **36** 395, etc.] included tests against *Musca domestica*, L., by the bell-jar method. The mortality percentages in 24 hours were 98 and 100 for 0·1 and 0·25 per cent. w/v Toxaphene and 99 and 100 for the same concentrations of aerosol-grade DDT, all in deodorised kerosene, as compared with 44 for the Official Test Insecticide; 0·5 ml. spray was delivered under 12·5 lb. pressure. When the concentration was maintained at 0·1 per cent. and the volume of spray atomised into the chamber varied, Toxaphene gave about as high mortality in 24 hours as DDT for all volumes greater than 0·3 ml., and when the volume was maintained at 0·5 ml. it was inferior to DDT at all concentrations less than 0·1 per cent. As Toxaphene does not give knockdown, Thanite [isobornyl thiocyanoacetate] [*cf.* B **36** 166] was added to it for this purpose in tests by the large-group Peet-Grady method [B **26** 245]. Whereas 0·125, 0·25 and 1·25 per cent. Toxaphene gave no knockdown in ten minutes and 71·6, 85·6 and 96·6 per cent. mortality in 24 hours, the addition of 1, 1·5 and 2 per cent. Thanite to all three sprays gave complete knockdown and increased the mortality percentages to 89·7, 93·6 and 93·7, respectively, for 0·125 per cent. Toxaphene and to 100 for the higher concentrations.

Tests of effectiveness of spray residues were carried out in cubical glass cages having a side of 16·25 ins. and spaces between the panels to permit the circulation of air. Each side was sprayed with 3 ml. of a 5 per cent. w/v solution of Toxaphene or DDT in acetone on 3rd July 1945, and batches of 100 flies were released in each cage on 6th July and at approximately monthly intervals thereafter for a year. The times required for paralysis and death of all the flies at the beginning and [in brackets] at the end of the experiment were 17 [25] and 258 [360] minutes for DDT and 108 [135] and 222 [378] minutes for Toxaphene, respectively. A further test was made in 1946, when sections of the interiors of two large dairy barns were sprayed on 12th May with emulsified solutions at a rate to give 125 mg. Toxaphene or DDT per sq. ft. The flies present were predominantly *M. domestica*, and counts on marked areas showed that the numbers were very markedly reduced on the day of spraying and the totals of four weekly counts were still considerably less than in neighbouring untreated barns in August. The Toxaphene appeared to be quite as effective as the DDT.

Tests were made by a direct-spray method [*cf.* B **36** 187] against batches of ten adult males of *Blattella germanica*, L., 0·5 ml. spray being delivered under 5 lb. pressure, and the percentage mortalities in 24 hours were 73, 95, 100 and 100 for 1, 2, 2·5 and 5 per cent. Toxaphene in kerosene, 49, 72, 95 and 100 for the same concentrations of DDT and 46 for the O.T.I. When 2, 3 and 3·75 per cent. Thanite was added to sprays containing 0·75, 1 and 1·25 per cent. Toxaphene or DDT, respectively, the mortalities were 90, 92 and 95 for Toxaphene and 94, 93 and 94 for DDT. In similar tests against *Cimex lectularius*, L., the percentage mortalities after 24 and [in brackets] 48 hours given by 0·3, 3·5 and 5·7 per cent. Toxaphene, 0·2 per cent. Toxaphene with 0·8 per cent. Thanite and the O.T.I. were 49 [49], 43 [97], 100 [100], 91 [100] and 79 [79] for first-instar nymphs, 40 [44], 63 [73], 87 [95], 62 [74] and 58 [62] for third-instar nymphs, and 18 [57], 36 [85], 52 [94], 47 [81] and 44 [69] for adults; the percentages of sprayed eggs that failed to hatch were 19, 29, 27, 42 and 30, respectively. The effectiveness of spray residues against bed-bugs was tested by spraying petri dishes with acetone solutions to give deposits equal to 100 mg. per sq. ft. and placing adults in the dishes when the acetone had evaporated. The percentage mortalities after 24 hours were 30 for Toxaphene, 64 for DDT,

82 for Thanite and Toxaphene (2 : 1) and 90 for Thanite and DDT (2 : 1); the last two deposits gave complete mortality in 42 and 48 hours, respectively, and the first two 99 and 97 per cent. after 55 hours, when the test was concluded.

Toxaphene has been reported to be somewhat less toxic than DDT to larvae of *Anopheles quadrimaculatus*, Say, in the laboratory [*cf.* B **36** 8], but in tests against larvae of *Aëdes sollicitans*, Wlk., Toxaphene at 0·2, 0·4 and 1 lb. per acre gave maximum reductions of 98, 100 and 100 per cent. in salt-marsh pools, as compared with 7 per cent. for no treatment, while DDT at the same rates gave 99, 100 and 100 per cent. In laboratory tests in water from salt-marsh pools, DDT gave complete mortality at all three rates, while Toxaphene gave 98, 99 and 100 per cent., as compared with 19 per cent. for no treatment.

Tests on human subjects showed that Toxaphene is neither a skin irritant nor a skin sensitiser, and acute toxicity studies on white rats indicated that it is considerably less toxic in deodorised kerosene than in maize oil. The maximum dose that killed none of ten or more rats, the dose that gave 50 per cent. mortality, and the smallest dose that gave complete mortality were 73, 120 and 145 mg. per kg. body-weight for Toxaphene and 70, 115 and 230 mg. per kg. for DDT, both in maize oil, and the corresponding doses of Toxaphene in maize oil for dogs were 10, 20–30 and 50 mg. per kg. Toxaphene appeared to kill dogs by stimulation of the central nervous system, and treatment with sodium pentobarbital, a depressant of the central nervous system, prevented the death of five of six animals that received 60 mg. Toxaphene per kg.

Erzin (N.) & Payzin (S.). **Akçakale vebası.** [Plague in Akçakale.]—*Turk. Bull. Hyg. exp. Biol.* **7** no. 3 pp. 31–46, 2 figs., 1 chart. Ankara, 1947. (With a Summary in English.)

An outbreak of plague occurred in 1947 in Akçakale, close to the Syrian border of Turkey. In addition to medical treatment and the usual prophylactic measures, details of which are given, DDT was used liberally to control fleas. A 5–6 per cent. solution in oil was used to treat clothing, houses and stables, and infected and uninfected sections of the population were moved to temporary camps. A campaign against rats was instituted at the same time, and the houses were subsequently carefully sprayed with the solution 12 times at intervals of two days, and kept closed. This treatment gave excellent control of fleas, and incidentally of other household insects.

Carter (H. F.) & D'Abrera (V. St. E.). **Mites (Acarina)—a probable Factor in the Aetiology of spasmodic Bronchitis and Asthma associated with high Eosinophilia.**—*Trans. R. Soc. trop. Med. Hyg.* **39** no. 5 pp. 373–395, 1 fig., 23 refs. London, 1946.

An account is given of further investigations in Ceylon [*cf. R.A.E.*, B **33** 11] on the relationship of mites to respiratory disorders in man [*cf.* also **33** 58]. Over 200 samples of sputum were examined from 24 patients who were or had recently been suffering from respiratory disorders and had an initial eosinophil count of at least 6–85 times the normal. Mites of various species were found at one time or another in the sputum of each patient and also in the urine of three who had concomitant urinary disorders. The number of mites in a single 24-hour sample of sputum ranged from one to 20, but was very seldom higher than three. Approximately 75 per cent. of the mites were Tarsonemids or Tyroglyphids. All stages, including hypopial nymphs of a Tyroglyphid, were found, and in two patients, all stages of the same species occurred in two successive 24-hour samples of sputum. The possibility that certain Tyroglyphids and Tarsonemids may become established in the respiratory tract and breed there is considered by no means remote. Both the number of positive samples and the

average number of mites present in these showed a marked decrease after some days' treatment by oral administration of organic arsenicals. The response to treatment was rapid and involved a great reduction in eosinophilia in all the patients, and cessation (permanent except in one case) of the clinical symptoms, which were chiefly of bronchial asthma and had been present for periods ranging from three weeks to 17 years. The results of blood counts and sputum examinations are shown in full in tables, and slight modifications of the technique used in the earlier work [**33** 12] to reduce risk of contamination to an absolute minimum are described.

Particulars of the cases are given in more or less detail, and the part played by the mites is discussed. The function of eosinophils is probably to neutralise toxins of protein origin. It would appear that the mechanism involved in the development of asthma associated with eosinophilia is first the development of the eosinophilia as a result of the presence of introduced protein, then production of histamine (a cleavage product of protein) by the disintegration of dead organisms, by toxic emanations from living organisms or by damage done by them to the tissues, and finally the absorption of the histamine by the eosinophil cells (which have been shown to be carriers of it) and its transportation by them to the vaso-motor centres where the asthmatic spasm is initiated. The degree of eosinophilic response depends on the sensitivity of the individual to the particular protein.

TAYLOR (F. H.) & MURRAY (R. E.). **Spiders, Ticks and Mites including the Species harmful to Man in Australia and New Guinea. Section 1. Descriptive. Section 2. Clinical.**—*Serv. Publ.* (*Sch. publ. Hlth trop. Med.*) *Dep. Hlth Aust.* no. 6, [1+] 275 pp., frontis., 6 pls., 184 figs., refs. Sydney, 1946.

The first (descriptive) section of this publication is by the late F. H. Taylor and consists mainly of descriptions from the literature of spiders poisonous to man in Australia and of ticks and mites of species known to cause direct injury or transmit disease to man by biting and of species allied to them in Australia and New Guinea. It includes a diagram elucidating the structural details of a spider, definitions of the terms used in describing Acarina, figures of most of the spiders, ticks and mites described, and keys, almost entirely quoted from other publications, to the more important groups and species of ticks and Trombiculids. The mites dealt with belong to six families ; most of the Trombiculids are included because of the lack of knowledge as to which of them attack man or cause disease. Hosts and locality are normally given for ticks and mites, and an account is included of the life-history of *Sarcoptes scabiei*, Deg., in man.

In the second section, which deals with clinical aspects in man, R. E. Murray describes the symptoms, causes and treatment of tick paralysis brought about by *Ixodes holocyclus*, Neum., the symptoms that follow the bite of *Ornithodoros gurneyi*, Warb., and the symptoms and treatment of scabies caused by *S. scabiei* and the various types of dermatitis caused by *Tyrophagus* (*Tyroglyphus*) *longior castellani*, Hirst, *Pediculoides ventricosus*, Newp., Trombiculids, and *Dermanyssus gallinae*, Deg., *Liponyssus bursa*, Berl., and *L. bacoti*, Hirst. Notes are included on mites as internal parasites of man and on precautions against the species of *Trombicula* that transmit tsutsugamushi disease. Cases of poisoning by the spiders, *Latrodectus hasseltii*, Thorell, *Atrax robustus*, P.-Camb., and *A. formidabilis*, Rainbow, are described with particular reference to the variation that exists in the severity of the effects of bites of the first two species, which may be fatal. Only one case of a bite by *A. formidabilis* is recorded ; it was severe. Little is known about pathology or the nature of the venom of these spiders.

Recommended first-aid measures are discussed ; general treatment is so far only symptomatic. Prophylaxis consists of regular examination of potential haunts of the spiders near dwellings, particularly in privies.

Moursi (A. A.). **The Effect of Temperature on the Sex Ratio of parasitic Hymenoptera.**—*Bull. Soc. Fouad Ier Ent.* **30** pp. 21–37, 1 fig., 3 graphs, 20 refs. Cairo, 1946. **The Effect of Temperature on Development and Reproduction of** *Mormoniella vitripennis* **(Walker) (Hymenoptera : Chalcidoidea-Pteromalidae).**—*T.c.* pp. 39–61, 3 figs., 5 graphs, 45 refs.

The use of cold storage for keeping and shipping insect parasites is of importance in the practical application of biological control, but little is known of its influence on their sex ratio and reproduction. Studies on this were therefore made, using *Mormoniella vitripennis*, Wlk., reared on pupae of *Musca domestica*, L.

In the first of these papers, the observations on sex ratio are described and the factors influencing it discussed. Adult parasites and host puparia containing parasite larvae or pupae were kept at temperatures of −8, −1, 6, 11 and 16°C. [17·6, 30·2, 42·8, 51·8 and 60·8°F.] for periods ranging from seven to 63 days. The average sex ratios of the treated parasites and their progeny were compared with that of the total progeny of 39 females reared at 27·5°C. [81·5°F.], among which the proportion of females to males was 4·8 : 1 ; when the parasites were reared in large numbers by exposing 300–400 host pupae for 18 hours to approximately 200 female parasites, the proportion of females was reduced to 1 : 1 or 2 : 1, probably owing to superparasitism and elimination of females. Exposure to low temperatures in the pupal stage did not influence the sex ratio of the resulting adults, but when fully fed larvae were exposed to temperatures of 6 and −1°C., the proportion of females decreased with the period of exposure, owing to differential mortality. The sex ratio of the progeny was not affected when the parents were exposed as fully fed or feeding larvae to temperatures of 6°C. or lower, at which development is at a minimum, or as adults to 6°C. for 63 days at 11°C. for 49 days, provided that the latter were allowed to feed on honey for two hours every three days. When the parents were exposed as larvae to temperatures of 11 or 16°C., as adults to temperatures of 16, −1 or −8°C. or of 6 or 11°C. without food, or as pupae, the proportion of females among the progeny generally declined, and this decrease was correlated with the duration of the exposure period. It was shown to be due to partial or complete sterility in the males, an adverse effect produced on spermatozoa in males and in the spermathecae of fertilised females stored at −8°C. for three days or −1° for 25 days, and to biological defects in the females. Of 20 unmated females exposed to −1°C. for 25 days, only one mated successfully and of 27 stored at −8°C. for three days, 21 refused to mate. The possibility that low temperatures may cause a change of sex in the eggs before fertilisation is pointed out.

The second paper, which deals with the effect of low temperatures on development and reproduction, also includes an account of the bionomics, based largely on the literature, and discussions of the effect on reproduction of adult feeding on the host, theories of cold-hardiness in insects and the origin of females from unfertilised eggs of *M. vitripennis*. Immature stages kept at temperatures of 6°C. or lower cease development and require at least as long to complete it when returned to normal temperatures as if they had not been exposed to cold. Between 8 and 16°C., mortality among fully fed larvae and newly formed and advanced pupae of *M. vitripennis* and unparasitised pupae of *Musca domestica* increased gradually with the exposure period. After 7 and 21 days' exposure it was higher among the pupae of *Musca* than in parasite larvae or pupae and

higher among the advanced pupae of *Mormoniella* than among the newly formed pupae and the larvae, between which there was little significant difference. It was lowest among the parasite larvae at −1 and 6°C., among the newly formed parasite pupae between −1 and 11°C., and among the advanced parasite pupae and the pupae of *Musca* at 11°C. Of 218 parasite females that were exposed to −8°C. for three days and then transferred to 27·5°C., only 55 recovered; 30 of these were exposed to the low temperature for a further two days after they had fed on honey for three hours, and only 12 recovered. The number of adult progeny produced by females stored as fully grown larvae, pupae or adults at temperatures between −8 and 16°C. decreased as the exposure period increased, and the decrease was more abrupt at the lower temperatures. Females that had been exposed for equal periods as fully grown larvae or pupae to temperatures between −1 and 16°C. or as adults to 6–16°C. produced most progeny after exposure to the lower temperatures, but the number decreased below these ranges. Other females exposed as feeding larvae to 6°C. for 7, 14 or 21 days produced an average of 114, 132 and 143 offspring, respectively, and the corresponding figures following exposure at 11°C. were 113, 101 and 163. The increase was correlated with increasing mortality among the larvae and apparently resulted from the increased food-supply available to the survivors. The number of progeny of adult females stored at 6 or 11°C. for different periods during which they were allowed intervals of normal respiration but no food decreased more rapidly with the length of the exposure period than when food was available.

The ovarioles of females that were stored at 16°C. for 14 days without food contained few, if any, fully developed eggs at any time after being transferred to a temperature of 27·5°C., owing to absorption of the ovarian follicles and eggs caused by the inhibition of oviposition [*cf. R.A.E.*, A **24** 185]. In a few cases, the ovarioles of females stored at 16°C. for 21 days and at −8°C. for 14 days were shrunken or contained small nutritive chambers alternating with immature eggs. It is recorded that of a total of 15,935 parasites produced by 155 unmated females that were stored at temperatures of 11–27·5°C., three were females. These were produced by one unmated female (reared from egg to adult at 27·5°C.), which was subsequently dissected; no spermatozoa were found in the spermatheca. The ovaries of the progeny were normal.

McArthur (J.). **Malaria Transmission in Borneo.**—*Lancet* **251** no. 6413 pp. 117–118. London, 1946.

Anopheles maculatus, Theo., was formerly considered to be the chief vector of malaria in North Borneo, but it was observed in 1939 that it was often abundant in places where malaria was absent. In the plain of Tambunan, an area at an altitude of 2,000 ft. occupied largely by irrigated rice-fields, there was little malaria in the centre where Anophelines of several species bred most intensely, but it was universal in the surrounding jungle-covered hills and ravines in spite of apparently sparse breeding of *Anopheles*. This was taken as evidence that *A. maculatus* was the vector and that the incidence of malaria was proportional to the proximity of the hills. It was, however, only 25 per cent. in one hill village, although *A. maculatus* was particularly abundant there, since jungle clearing had created ideal breeding-places. Adult mosquitos appeared to be practically absent from even the most highly malarious parts of the hills, and a human bait trap virtually failed to make captures. Comparisons with animal bait, however, showed that practically all the Anophelines present greatly preferred animal blood, *A. maculatus* seeking it in 85 per cent. of cases. The only exception was *A. leucosphyrus*, Dön., a species apparently extremely rare in Tambunan, which preferred human blood in 90 per cent. of cases [*cf. R.A.E.*, B **24** 165, 256]. Finally, natives brought in females captured in

defective mosquito nets, and these all proved to be *A. leucosphyrus*. Dissections showed that this was a vector [*cf.* **23** 20, 21, 27 ; **30** 104], and almost certainly the only one in the locality, since 2,700 dissections of other species, including *A. maculatus*, were all negative. *A. leucosphyrus* was furthermore found to be breeding widely in the locality, but special methods of search were required for its discovery since it bred only in the jungle. It was thought to be the most widely distributed mosquito in Borneo. All-night watching showed that it entered houses long after midnight and left long before dawn. As a control measure, clearing of jungle around breeding places was begun and gave immediate control of *A. leucosphyrus*, but the Japanese occupation interrupted the experiment and prevented any determination of the effect on malaria.

It is concluded that *A. leucosphyrus* is probably a vector of malaria in many parts of the world where it has been considered harmless, its presence having been masked by its elusiveness and its infectivity by the presence of other more easily incriminated species.

Macan (T. T.). **Mosquitos and Malaria in the Kabaw and Kale Valleys, Burma.** —*Bull. ent. Res.* **39** pt. 2 pp. 237–268, 1 pl., 2 figs., 10 refs. London, 1948.

An account is given of malaria surveys carried out in the Kabaw and Kale valleys in Burma between 1942 and 1945. A general description is given of the topography and climatic conditions in these valleys, and their position is shown in a sketch map. Both drain through lateral gorges into the Chindwin River, with which they are parallel. The south-west monsoon brought rain in May, and there were heavy rains during June–September inclusive and very little rain from November to April. The Kabaw Valley is mainly wooded, but a large area of the Kale Valley is cleared, and this is the more heavily populated. Rice is the main crop. The incidence of malaria was uniformly high throughout the valleys, transmission being most intense during May–December. Spleen rates in the villages are shown in a table ; only one village out of 23 had a spleen rate under 60 per cent.

A list is given of the 17 species of *Anopheles* taken, and detailed figures for adult and larval collections made in different years and seasons and in various localities are shown in tables and the findings discussed. Common species during the rains were *Anopheles minimus*, Theo., *A. leucosphyrus*, Dön., *A. philippinensis*, Ludl., *A. jeyporiensis*, James, *A. annularis*, Wulp, *A. hyrcanus* var. *nigerrimus*, Giles, and *A. vagus*, Dön. *A. minimus* was only locally abundant at this time ; *A. leucosphyrus* was widespread but confined to the forest. The only common and widely distributed species during the dry season were *A. minimus* and *A. maculatus*, Theo. The results of dissections for sporozoites and the figures for mosquitos containing fresh blood (almost certainly human) and for those caught indoors at night containing old blood are given in tables. The only species in which sporozoites were found were *A. minimus* and *A. leucosphyrus*. The sporozoite rates of the former were 0·63, 3·66 and 1·94 per cent. in October, December and May, respectively, in the dry season, when it was the only vector, but in September its sporozoite rate was only 0·31 per cent., while that of *A. leucosphyrus* was 1·49 per cent., and the latter was consequently thought to be the important vector during the rains. It has been found infected at three other places near the Indo-Burmese border [*cf. R.A.E.* B **30** 104], and there is evidence that it is a major vector in Borneo [see preceding abstract]. A theory that it increases in abundance as a result of military activity is discussed. It bred in " luwins " (sinuous marshy areas in the forest that contain water about a foot deep in the rainy season with emergent and other aquatic vegetation) and in backwaters, puddles and slit trenches, and larvae were also found in abandoned ammunition boxes and in a pool on a tarpaulin. *A. minimus* bred principally in streams.

There was little correspondence between breeding places and localities where large adult catches were obtained. Collections of adults, mostly made at night in camps or villages, showed that the species found in large numbers near man were *A. minimus*, *A. leucosphyrus*, *A. philippinensis*, *A. jeyporiensis*, *A. annularis* and *A. hyrcanus*; *A. minimus* and *A. leucosphyrus* were the most successful in obtaining blood from men protected by mosquito nets. So far as could be ascertained from investigations mostly involving tents and shelters rather than houses, all the species concerned tended to rest in the forest, although 87 out of 223 examples of *A. minimus* taken indoors in the Kale Valley in November–December contained old blood, indicating that they had rested in the houses since the previous night, possibly because the forest in this valley was more distant from the villages. The evidence suggested strongly that *A. leucosphyrus* does not rest indoors. A study was also made of the times of maximum activity of some species throughout the night. The time of activity of *A. minimus* was rather variable. In September, it was usually during the early hours of the morning but sometimes in the first half of the night. In December, catches were good between 11 p.m. and 2 a.m. In May, individuals began to appear some four hours after sunset, but the heaviest attack was in the latter half of the night. *A. leucosphyrus* behaved with greater regularity than any other species. It began to appear at about 10 p.m., was fairly plentiful about 11 and was rare after 3 a.m. Catches before and after 1 a.m. were usually about equal. Morphological notes are included, bearing on characters distinguishing larvae of *A. pallidus*, Theo., from those of *A. philippinensis*, and adults of *A. minimus* from those of *A. aconitus*, Dön. The variation found in *A. minimus* was considerable.

HADDOW (A. J.). **The Mosquitoes of Bwamba County, Uganda. VI.—Mosquito Breeding in Plant Axils.**—*Bull. ent. Res.* **39** pt. 2 pp. 185–212, 8 pls., 2 figs., 16 refs. London, 1948.

In the course of investigations on the mosquitos of Bwamba County, western Uganda [*cf. R.A.E.*, B **35** 67, etc.], a study was made of breeding in plant axils, with special reference to *Aëdes simpsoni*, Theo., which breeds almost exclusively in them and is apparently the chief local vector of yellow fever [**31** 61]. The area and the various plants studied are described, and the results of two preliminary surveys are discussed. These confirmed that, so far as mosquito breeding is concerned, the most important plants in Bwamba are the lowland colocasia (*Xanthosoma sagittifolium*), the "gonja" group of cultivated bananas and the pineapple [*cf.* **31** 182]. It does not seem possible to make an accurate estimate of relative importance, as too many variables are involved. It was found best to survey colocasia and pineapples at the edge of plantations and to choose large colocasias and small banana plants. The size of pineapple plants and the position of the gonjas in the plantation appeared unimportant. Other plants need not be sampled. *A. simpsoni* comprised 93 per cent. of the larvae of all species taken in the inhabited lowland areas and was shown to occur in widely different types of lowland country. Records are given of the occurrence of larvae of *A. aegypti*, L., in plant axils. They formed 2 per cent. of the total taken in the survey of the inhabited lowland. A survey of 12 different kinds of plants is described, and it is shown that the larval populations (of *A. simpsoni*) depend considerably on the amounts of water retained by the axils of the plants. In Bwamba, medium-sized axils with a capacity of 4–8 cc. appeared to be the most favourable. Certain plants that yielded many larvae, such as wild banana, did not harbour *A. simpsoni*, apparently because they are confined to forest and mountain areas.

A monthly survey of axils of *X. sagittifolium* carried out from March 1942 to February 1943 showed that larvae of *A. simpsoni* were present in every month

and that fluctuations in their numbers depended on growth and harvesting of the plants rather than on rainfall, as a light shower was sufficient to fill the axils and once filled they retained the moisture for a considerable period. Larvae of *A. simpsoni* and *Harpagomyia taeniarostris*, Theo., hatched in 2–3 days from scrapings taken from dry axils during a short period of drought and placed in bowls of water in cages. The water in a *Xanthosoma* axil was cooler than the surrounding air, and the axil temperature was remarkably equable.

Systematic collections of pupae from axils of *Xanthosoma* showed that the output of adult mosquitos (which cannot be gauged directly from the population of larvae) is high and constant. It is estimated that a one-acre plot containing some 500 *Xanthosoma* plants may, under favourable conditions, produce about 5,000 adults or 2,000 females of *A. simpsoni* per month. Evidence is adduced that the influence of the predatory larvae of *Eretmapodites* spp. on the populations of other species is considerable, and the output of adults is also reduced by excessive growth of Protozoa on the larvae. The fauna of plant axils, apart from mosquito larvae, is briefly described.

Leeson (H. S.) & Theodor (O.). **Mosquitos of Socotra.**—*Bull. ent. Res.* **39** pt. 2 pp. 221–229, 4 figs., 15 refs. London, 1948.

A malaria survey of Socotra, carried out in December 1942 and January 1943 by the late T. P. Ward, showed the incidence of the disease to be high in all parts of the island, though December and January appeared to be the quiescent period. Extracts from his report, dealing with the geography, climate, population and Anopheline breeding places, are given. The mosquito material available for identification consisted of 22 adults caught in houses, 300 bred from larvae and 100 samples of larvae preserved in spirit. As there were no bred series containing adults with their respective larval and pupal pelts, identifications had to be made separately for adults and larvae, and the resulting list, which comprises *Anopheles dthali* var. *wardi*, n., *A. adenensis*, Christ., *Aëdes granti*, Theo., *A. vittatus*, Big., and five species of *Culex*, is therefore provisional. No Anopheline had previously been recorded from Socotra. The pupa and the adults of both sexes of var. *wardi* and the larvae believed to belong to it are described; characters distinguishing the adults of the two Anophelines are given in a table, and the sites where these were found breeding are shown on a map. Var. *wardi* appeared to be common all over the island, and larvae were taken from almost all types of water, irrespective of whether it was running or stagnant, clear or muddy, fresh or brackish, or shaded or open. They were common in shallow or deep wells, and at the edges of streams or lagoons, with or without algae. They were found alone on 67 occasions and in association with those of *A. adenensis* on 14; the latter was commonest on the northern coastal plain and was found 11 times alone and 11 times in wells. In Kallansiya, where var. *wardi* was the only Anopheline found, the malaria parasite rate in children was 78 per cent.

The larva and adult male of *Aëdes granti* are described for the first time; characters are given distinguishing the two species of *Aëdes* and keys to the larvae and adults of the five species of *Culex*, with notes on the breeding places of all these species.

Wilson (S. G.). **A Method of assessing the acaricidal Properties of DDT and "Gammexane" Preparations in Field Trials.**—*Bull. ent. Res.* **39** pt. 2 pp. 269–276, 2 figs., 3 graphs, 2 refs. London, 1948.

The advantages of DDT and BHC (benzene hexachloride) over arsenic for use in cattle dips are briefly discussed [*cf. R.A.E.*, B **35** 64], and an account is

given of tests carried out in Uganda in 1946 with sprays containing them. The preferred sites of attachment of various species of ticks common on cattle in that region are recorded. For convenience, the results of the experiments were assessed by counting the adults of *Rhipicephalus appendiculatus*, Neum., on the ears. Details are given of the manner in which the counts were made and of the apparatus used in spraying. The materials tested were an emulsion concentrate (A.19) containing 23 per cent. DDT (80 per cent. p.p' isomer) and dispersible BHC powder (P. 530) containing 6·5 per cent. γ BHC.

In preliminary tests the ears of four calves were sprayed by means of a flit gun with 25–30 cc. 5 per cent. p.p' DDT immediately before being kept on a tick-infested paddock, and again nine days later. Two other calves were given a single application of 5–10 cc. on the second day. The average daily counts of *R. appendiculatus* are shown in a table. After each application, the numbers of attached living ticks gradually decreased until the fourth day, after which they rose again. Engorging females were more resistant than males. It was concluded that such treatment would have to be repeated weekly to be effective. A similar test was made in the same paddock with three animals sprayed with 2·5 per cent. p.p. DDT, three sprayed with 0·65 per cent. γ BHC and three untreated controls. The total numbers of ticks counted on their ears over 14 days are given in a table, and showed that both treatments remained effective for four days, after which the numbers of ticks increased.

Sprays containing 5 and 2·5 per cent. p.p' DDT or 0·65, 0·065 and 0·325 per cent. γ BHC were then applied under field conditions with an Aerograph spray gun to groups of four calves each about two years old, a similar group being used as controls. The ears of the animals were sprayed weekly for 14 weeks, except that in the twelfth week they were treated twice, on the first and fourth days. Counts were made approximately twice weekly, and the results are shown on graphs. The ticks on the ears of animals sprayed with DDT were less numerous throughout the experiment than those on the controls, but their numbers always increased between the fourth and seventh days after treatment, except in the week when the double application was made. Treatment twice a week is therefore advised during the early weeks of a tick eradication campaign. The 2·5 per cent. DDT, which was used during the latter part of the experiment only, appeared to be slightly more effective than the higher concentration. The control obtained with 0·65 per cent. γ BHC was comparable to that from 5 per cent. DDT and was about as lasting; 0·325 per cent. was about as effective but 0·065 per cent. was insufficiently toxic. In a final test, coumarone resin was added to a 25 per cent. dilution of A.19 at 1 lb. per gal. and the plain emulsion and the mixture diluted to contain 2·5 per cent. p.p' DDT. These were applied twice to the ears of cattle over a period of three weeks, and counts made as before. The population trends closely resembled those in the previous tests, and the addition of the resin did not prolong the toxic action of the DDT.

Laws (S. G.). **A biological Test for assessing the acaricidal Properties of DDT and "Gammexane" Preparations.**—*Bull. ent. Res.* **39** pt. 2 pp. 277–279, 1 fig. London, 1948.

The author describes a laboratory method of testing sprays and dips for use against cattle ticks designed to reproduce the conditions experienced in the field in that the ticks are subjected to an initial wetting, comparable to that received when cattle are dipped or sprayed, and remain afterwards for a few hours on a moist surface and then for a longer period in contact with the dried deposit as when attached to the host. Two open-ended glass tubes are lined with thin white filter paper and the liquid under test distributed evenly over the paper by pipetting into each end of the tube half the quantity sufficient to

moisten it completely. One of the papers is then taken out and cut into two portions, for use as end covers. One of these is folded over one end of the other tube and bound in position with a strip of gummed paper to form a cap that can easily be removed and replaced, and the tube, open end upwards, is stood on a glass plate. The ticks under test are placed in a petri dish on a sheet of filter paper thoroughly saturated with the liquid and a wad of cotton-wool similarly saturated is pressed firmly and evenly over them. Ten ticks are treated and dropped one by one into the prepared tube, which is then closed with the remaining portion of filter paper; this impregnated lining remains moist for 3–6 hours at room temperature. A control tube is prepared for each test, using distilled water. The tubes are stored in a horizontal position, and observations for mortality made after 6, 24, 48 and 72 hours. Most of the ticks in the controls remain alive and active throughout this period, and the quickest results are obtained with adult males. All glassware is cleaned by threefold immersion in kerosene and finally boiled in soap solution. A table shows the results of a few selected tests in which complete mortality of males of *Rhipicephalus appendiculatus*, Neum., was obtained with an arsenical dip and, more quickly, with A.19 and P.530 [*cf.* preceding abstract] at concentrations giving 5 per cent. p,p'DDT and 0·65 per cent. γ benzene hexachloride, while all ten control ticks survived.

COCKINGS (K. L.). **Successful Methods of trapping *Trombicula* (Acarina) with Notes on rearing *T. deliensis*, Walch.**—*Bull. ent. Res.* **39** pt. 2 pp. 281–296, 5 figs., 3 refs. London, 1948.

A description is given of a trap for collecting larvae of *Trombicula* from areas where the population is small. It was devised and used with success in England for *T. autumnalis*, Shaw, in 1946, but it is hoped that it will be equally effective for *T. akamushi*, Brumpt, and *T. deliensis*, Walch, the vectors of tsutsugamushi disease. Its effectiveness is due to activation of the larvae by warmth, their attraction by light, and their tendency to crawl upwards. Larvae of *T. autumnalis* and those of *T. deliensis*, which were studied in Assam in 1945, were both activated to brisk movement when warmed and showed a strong tendency to climb, even when in the dark. The trap consists of a tray with a hole in the centre to admit light and hold the trapping device. The tray is inverted over the earth and the larvae reach the trapping device by crawling over a cone of filter paper placed on a dish beneath it and moistened. The temperature inside the trap was higher than outside. Trapping for 4½–5 hours under warm, dry conditions gave a representative number of larvae (up to 154 per square yard). In preliminary tests of bait animals, guineapigs and golden hamsters (*Cricetus auratus*) were the most satisfactory. The numbers of mites caught in the trap and those picked up by two guineapigs and two hamsters confined under a frame covering the same area were similar only when the minimum air temperature exceeded 55°F. At lower temperatures, there were more mites in the trap than on the animals, presumably because it was warmer under the tray. Nearly all the larvae that attached to guineapigs did so near the anus and genitalia. On the hamsters, they were more evenly distributed between these areas and the ears. Over 80 per cent. of the larvae left the host 30–60 hours after attachment. A method of anaesthetising the animals for examination is described.

A laboratory light-trap for collecting engorged larvae leaving their host, or any larvae leaving dead animals or débris, was devised in Assam and successfully used also in England. The host is in a box and the larvae from it crawl through a funnel of black paper towards a lamp. Unengorged larvae left a dead animal almost at once and those sufficiently engorged to undergo metamorphosis within four hours. Those that had fed for only a short time remained for 24 hours

or more. It was thus possible to sort larvae appearing in the trap into sizes by changing the container.

Larvae of *T. autumnalis* were sometimes taken in small numbers by flagging when few were taken in traps and none on boots. In such cases, collection was facilitated by putting the cloth rolled on wire netting in the box of the light-trap. Adults were recovered from soil by flotation, preferably in warm water, but the method was less suitable for nymphs, as they are more fragile and more easily wetted, though some floated. Adults were recovered in numbers on chalk-down only from soil within five yards of rabbit burrows, and more were found beneath bushes than under short grass. They rose towards the surface of moist soil when the temperature was high and penetrated deeper into it when temperature approached or reached freezing point. They appeared to go deeper into the soil towards moisture under very dry conditions and to rise after the first rain following a prolonged dry period. Those near the surface under turf appeared to go deeper after heavy or continuous rain. There was a sharp seasonal peak in larval abundance in September 1946, with some evidence that it was related to a peak in oviposition.

To rear *T. deliensis*, fully engorged larvae in batches of 100 were placed in cloth-bottomed, shallow metal cells, closed with cover slips held in place by wax, and kept on a wet filter paper diaphragm over water in a petri dish with a darkened lid for 24 hours. Larvae partly immobilised by a thin film of water apparently became nymphophanes much more quickly. The dark cover prevented the larvae from climbing to the cover slips and being caught in condensation. After 24 hours, the cells were transferred to a dish in which the filter paper was kept moist but not wet, and as soon as the larvae showed signs of undergoing metamorphosis, the cell was lightly flooded and the nymphophanes were picked off and placed singly in cells having bases made of black cloth in which the larval pelts could be easily seen. At 30–33°C. [86–89·6°F.], nymphs emerged in 6½–8 days. They were then mounted or put into tubes containing soil. Those that were alone died, but when many were kept together, some reached maturity, and it was realised that some nymphs were preying on others. Nymphs emerged in about seven days from larvae put into darkened tubes one-quarter filled with very moist soil over which dry soil was added after 24–48 hours. On the appearance of the nymphs, which avoid bright light, the black cover was moved to the lower end of the tube to keep them in the soil. No adults appeared in tubes containing cell-reared nymphs only, but some were obtained in tubes containing a number of cell-reared nymphs and fully and partly engorged larvae. Fungal mycelia occurred in the soil in many of the tubes, but no adults appeared in these. No adults bred from larvae were found to have laid eggs, but a few larvae were obtained from eggs laid by an adult that had been recovered from the soil. Nymphs usually became inactive in dry soil but were activated even at a depth of 2–2½ ins., when a drop of moisture was put on the surface. Larvae left a host prematurely following undue handling or activity. Nymphs of *T. autumnalis* in the laboratory were seen to feed on partly engorged larvae and on a nymphophane.

RADFORD (C. D.). **Notes on *Trombicula deliensis* Walch, 1923 (Acarina ; Trombidiidae), with Description of the Adult.**—*Parasitology* **37** no. 1–2 pp. 42–45, 9 figs., 6 refs. London, 1946. **Larval and nymphal Mites (Acarina ; Trombiculidae) from Ceylon and the Maldive Islands.**—*T.c.* pp. 46–54, 29 figs., 8 refs.

In the first paper, an account is given of the technique and results of an attempt to rear *Trombicula deliensis*, Walch, in Ceylon between May and

August 1944. Nymphs were reared from larvae found in nature on the ears of rats, but no adults were obtained from them. However, larvae later identified as *T. deliensis* were bred from adults found in soil, and from the latter individuals, the adult of *T. deliensis* is described for the first time. A list is given of five small mammals and three birds from which larvae were taken in the field. No adults were found amongst vegetation near burrows of rodent hosts of the larvae ; a few were found in the soil from the entrances of burrows within 3 ins. of the surface (but none at greater depths) and others beneath coarse, low-lying grass under trees, which conserved the surface moisture of the soil. None was found in the grass. The easiest method of examining soil was to place it in trays and cover it with rain-water so that mites and other fauna floated.

To rear larvae, a little washed sand and some crushed, dead leaves moistened with rain-water were placed in a glass specimen tube, part of a rat's ear with the mites attached was added, and the tube was corked. On the following day, when most of the mites had burrowed into the soil, the ear was removed. For 48 hours after the mites were placed in the tube, some could be seen walking on the glass, but few after this. There were nymphs in the tube on the ninth day, and in some instances a nymph could be seen inside the transparent larval skin. The emergence of nymphs was observed several times. In one instance, the nymphs did not appear until the sixteenth day. Sometimes, the proportion of larvae transforming was small, but once it was 73 per cent. The nymphs remained active for 2–3 days, but all died within four days. When attempts were made to feed them on potato juice, they were either poisoned or drowned by it.

For ease of examination, glass staining cells $1\frac{1}{2}$ ins. square with a central cavity were used instead of tubes when larvae were being bred from adults. Sand, leaf-mould and rain-water were placed in them and the cover was attached with a thin smear of vaseline to prevent mites escaping. To keep the cells ventilated and prevent the formation of mould, covers were made of aluminium with a central hole $\frac{3}{4}$ in. in diameter over which a piece of bolting silk was gummed. Three or four drops of rain-water were added to each cell night and morning as required. When the moisture of the soil had evaporated during the day, the mites remained inactive, but they became active again when water was added. No eggs were seen in cells containing adults of *T. deliensis*, but one cell contained two larvae 19 days after preparation, and another contained two on the next day. Mortality among adults was great. No more than one ovum was ever found in a single adult, several hundred of which were examined. In one adult, a fully formed larva could be seen inside the ovum *in situ*. Adults soon died at humidities below 90 per cent., and in dry sand, all died within 24 hours. Four out of five adults kept in a corked specimen tube with a small strip of damp blotting paper were still alive and very active after 25 days, but no eggs or larvae were found.

In the second paper, descriptions are given of the larvae of *Walchia turmalis*, Gater, from Ceylon, the larva of *Womersleyia minuta*, gen. et sp. n. (LEEUWENHOEKIINAE), the larva and nymph of *Schöngastia maldiviensis*, sp. n., *Trombicula acuscutellaris*, Walch, and *T. deliensis* and the larva, nymph and adult of *Neoschöngastia indica*, Hirst, all from the Maldive Islands and the last two from Ceylon also. The collections in Ceylon were made from April to August 1944 and those in the Maldive Islands from November 1944 to February 1945. The hosts of the larvae of each species are given. The larvae of *W. minuta* were taken in mud and later found to be parasitic on grasshoppers (Acridids, Tetrigids and Tettigoniids) and those of *S. maldiviensis* were taken on lizards (*Calotes*) and occasionally on rats. The nymphs were all reared. The adults of *N. indica*, which have not previously been described, were found

amongst the dead flowers and leaf débris at the top of coconut palms. Much of the information on breeding technique in the first paper is in this one also.

LEES (A. D.). **The Water Balance in *Ixodes ricinus* L. and certain other Species of Ticks.**—*Parasitology* **37** no. 1-2 pp. 1–20, 8 figs., 29 refs. London, 1946.

In Britain, *Ixodes ricinus*, L., occurs only in rough grazings where the ground is usually poorly drained and decomposing plant material forms a mat retentive of moisture [*cf. R.A.E.*, B **32** 232]. Such a habitat provides a microclimate in which the humidity remains high throughout the year. The various stages of the tick are known to show little resistance to desiccation [**24** 249, etc.]. The correlation between tick distribution and type of vegetation is probably indirect, depending on the influence of the type of substratum on humidity. Studies on the manner in which the tick gains or loses water and the physiology of these exchanges are dealt with in this paper.

The following is taken from the author's summary. The unfed tick gains water from humid air or from water in contact with the cuticle, and loses water by evaporation. Whilst attached to the host, the tick is gaining water from the ingested blood and losing water in the excrement. The engorged tick usually lacks the ability to take up water from humid air. The exchange of water takes place mainly through the cuticle. Regulation of the water balance is therefore brought about by the activity of the epidermal cells.

The cuticle comprises two principal layers, the epicuticle and endocuticle. The epicuticle is overlaid by a lipoid possessing important waterproofing properties. The pore canals, which traverse the endocuticle, are occupied by cytoplasm, and may in consequence play an important part in the active transfer of water through the cuticle. They do not penetrate the epicuticle. Water loss from the unfed tick is not closely related to saturation deficiency, particularly at high humidities, because of the ability to secrete water. Through this activity, a state of equilibrium is attained at a relative humidity of about 92 per cent. At lower relative humidities, the tick loses water by evaporation and at higher humidities it takes up water. The retention of water at lower humidities is due not only to the physical properties of the epicuticle but also to the secretory activity, for water loss increases when the tick is temporarily asphyxiated, poisoned with cyanide or injured through excessive desiccation. Near the point of equilibrium, the loss or gain of water over a wide range of temperature is determined by the relative humidity.

Water is taken up from humid air when the tick is desiccated, but not when the normal water content is restored. After exposure to saturated air, a tick first loses water at relative humidities above the point of equilibrium, but later comes to retain water completely. Both unfed and engorged ticks can prevent or limit temporarily the entry of water in contact with the cuticle. The engorging female, originally weighing about 2 mg., ingests about 600 mg. blood. About 300 mg., or two-thirds of the contained water, are usually eliminated before the end of engorgement. Evaporation from the cuticle may account for a considerable part of this, as the temperature of about 37°C. (98·6°F.) at which the tick is then exposed is above that at which marked increase in the permeability of the epicuticular lipoid takes place. Eight other species of ticks were examined and found to differ considerably in their powers of limiting evaporation. This may reflect specific differences in the nature of the epicuticular lipoid. *I. ricinus* lost water most rapidly and 10–15 times more rapidly than *Dermacentor andersoni*, Stiles. The more resistant species also take up water through the cuticle after desiccation. The rate of uptake over a unit area of cuticle is about the same in all Ixodids, and uptake thus appears to be limited by the ability of the epidermal cells to secrete water.

MILNE (A.). **The Ecology of the Sheep Tick, *Ixodes ricinus* L. Distribution of the Tick on Hill Pasture.**—*Parasitology* **37** no. 1–2 pp. 75–81, 2 graphs, 6 refs. London, 1946.

In this paper, further details, based on work on a Cheviot hill farm, are given on the distribution of *Ixodes ricinus*, L., on hill pasture, on which earlier investigations have already been noticed [*R.A.E.*, B **32** 232]. The following is mainly from the author's summary. Counts from a series of drags showed that sheep paths and their borders had tick populations similar in density to that of the general pasture, and that sheep lairs (night resting places) had significantly lower nymphal densities, and slightly lower adult densities, than the general pasture. These lairs were invariably composed of fine short herbage on dry ground. On the typical hill, the vegetation layer generally became thinner, and nymphal density decreased, with altitude. The difference was less clear with adults of either sex than with nymphs. If, however, vegetation conditions were suitable, altitude had no limiting effect on nymphal density within the range studied (500–1,050 ft. above sea level). Tick density was therefore a function of vegetation conditions, the latter usually being affected by altitude.

The distribution of ticks on areas of apparently uniform vegetation was studied. The blanketing method of sampling populations [*cf.* **32** 105] and the influence of time on the activity of the ticks [**33** 165–166] and of area sampled on the reliability of the results are discussed. It is concluded that probably no more than 12 nymphs per square yard of ground are present on the average in heavily infested pasture. The numbers of nymphs per 100 square yards differed significantly ; the approximate number per acre also differed significantly in rather more than half the cases observed. Larger area-units within uniform stretches of pasture are thought to carry similar numbers of ticks.

Detailed results are shown in tables and graphs, and practical applications of the findings to the study of tick control by pasture improvement are indicated.

LEWIS (E. A.). **Nairobi Sheep Disease : the Survival of the Virus in the Tick *Rhipicephalus appendiculatus*.**—*Parasitology* **37** no. 1–2 pp. 55–59, 6 graphs, 5 refs. London, 1946.

The author describes experiments in Kenya to discover the length of time for which the virus of Nairobi sheep disease [*cf. R.A.E.*, B **20** 20] remains infective in the bodies of unfed ticks, with a view to establishing a quarantine period for pastures. Five males and five females of the chief vector, *Rhipicephalus appendiculatus*, Neum., infected a healthy sheep by feeding 136 days after moulting and 156–161 days after the conclusion of an infecting meal on a sheep inoculated while they were attached. The females were slower in attaching than the males, and the first engorged female did not drop until the 12th day. Other adults from the infected nymphs were kept unfed for 212 days and then placed on a sheep, which gave no reaction but was later shown to be immune from the disease. Groups of ten adults from another series infected as nymphs transmitted the disease to sheep on which they fed after starvation for 395 and 528 days, respectively, as did a third group fed after 618 days, but the incubation period of the disease induced was slightly longer. Two groups of 20 adults from another series infected as nymphs transmitted the disease when still older, the virus having retained its virulence in them for 775 and 871 days, respectively, including the moulting period.

As male ticks sometimes wander over the sheep in search of females and may pass from one sheep to another, the part they might play as vectors was investigated. Males that had fed on an infected sheep were kept in a rearing tube for 13 days, when 16 out of 22 had died. The survivors were fed, with six uninfected females, on a sheep, and it reacted to Nairobi sheep disease and died 16 days after infestation.

Various groups of nymphs, infected as larvae, transmitted the disease to sheep, sometimes in fatal form, after starvation for 114–288 days. Two of the sheep had previously failed to react to larvae reared from an infective female. The nymphs used were active and eager to feed, but others from the same series failed to withstand longer periods of starvation ; when placed on sheep, most failed to attach and died. Of 50 nymphs placed on a sheep after 327 days' starvation, only seven attached and only three succeeded in feeding to repletion, and of 18 after 348 days only one fed to repletion, but in both cases the disease was transmitted to the sheep. It was concluded that the virus could survive at least 359 days in unfed nymphs in the laboratory.

The eggs of females of *R. appendiculatus* infected on a sheep inoculated with virulent blood and kept at 77°F. hatched 32–38 days after the adults dropped from the hosts. Many of the larvae were placed on a sheep 79 days later and over 600 were recovered engorged. The sheep died of Nairobi sheep disease after a week. About 2,000 engorged larvae were recovered from the ears of another sheep that had been infested with larvae 144 days old and which sickened but recovered. A third batch, starved for 186 days, did not feed well ; only a few attached and no replete ticks were recovered. Nevertheless, the disease was transmitted, but with an abnormally long incubation period. Of two more lots of larvae, starved for 245 days, most were unable to feed, but 11 and four replete ticks, respectively, were recovered after 6–8 days. No definite febrile reaction took place in either of the sheep, except for an abrupt rise in temperature on the 14th day, and subsequent tests showed that they had not been infected. Broods of larvae 294 days old were put on the ears of the sheep subsequently used with nymphs, but failed to attach and all were found dead in the ear-bags 18 hours later.

The febrile reaction of infected sheep is in many cases shown graphically. It is concluded that the causal agent of Nairobi sheep disease, once it has been introduced into an area where *R. appendiculatus* exists, will probably persist so long as unfed, infected ticks remain on the land.

Lewis (E. A.), Piercy (S. E.) & Wiley (A. J.). *Rhipicephalus neavei* **Warburton, 1912 as a Vector of East Coast Fever.**—*Parasitology* **37** no. 1–2 pp. 60–64, 4 graphs, 2 refs. London, 1946.

An account is given of laboratory investigations into the ability of ticks from Kenya identical with those described by Warburton as *Rhipicephalus neavei*, to transmit *Theileria parva*, the causal organism of African coast fever of cattle [*cf. R.A.E.*, B **28** 76]. Zumpt considers *R. neavei* to be only an aberration of *R. appendiculatus*, Neum., the usual vector, but the authors believe them to be morphologically distinct though closely allied biologically. Since the natural distribution of *R. neavei* frequently overlaps that of *R. appendiculatus* and extends widely into areas where the latter is not present, it was thought that it might maintain infection in some areas where the disease occurs sporadically and contribute to periodic outbreaks outside the scheduled endemic areas. Larvae of *R. neavei* were infected on an animal to which the disease had been transmitted by nymphs of *R. appendiculatus*. Engorged larvae began to drop on the sixth day, when piroplasms were common in blood smears from the host, and 730 replete larvae were recovered before the animal died. They were kept at 77–78·8°F. and moulted in 11–12 days. Two batches of 100 of these nymphs were put to feed, 15 days after moulting, on susceptible calves. Only 10 and 11, respectively, fed to repletion ; the rest died without becoming attached. One calf developed a fever on the 15th day after infestation and died on the 30th, the other reacted after 14 days and died after 33. The results of post-mortem examination were identical in both cases, neither calf showing

typical lesions of African coast fever, but smears prepared at death from glands, spleen and blood contained numerous gamonts, agamonts and piroplasms of *T. parva*. A third batch of the same nymphs, having been starved for 64 days after moulting, were placed on an adult steer. Only 20 fed to repletion. The steer showed a temperature reaction between the 14th and 24th days after infestation and then recovered. Koch's bodies had been fairly common in gland smears between the fourth and eighth days of the reaction ; piroplasms in the blood were always rare. The animal later proved immune from a virulent strain of African coast fever.

In subsequent experiments, the ticks received their infecting feed on cattle infected by their own species in order to determine the ability of *R. neavei* to maintain infection in the absence of *R. appendiculatus*. An unexpected difficulty was encountered in tests involving larvae, because those from many broods failed unaccountably to feed satisfactorily on the ears of cattle. From one batch of uninfected larvae that fed successfully on a reacting bovine, 370 replete larvae were recovered. The resulting nymphs, after 30 days' starvation, fed well on two fully grown steers, which reacted after 14 and 15 days, respectively, and both died 35 days after infestation. Post-mortem examination revealed typical lesions of African coast fever ; apart from this, the disease showed no difference from that in the previous test animals. In experiments with adults infected as nymphs, ticks fed on two steers provoked a reaction conforming with that produced by infective *R. appendiculatus*, after an incubation period of 13 days, and post-mortem examination of the cattle showed the usual lesions of African coast fever. In tests of the survival of the parasite in *R. neavei* two lots of adults infected as nymphs, comprising, respectively, 12 males and 20 females and 20 males and 35 females, were kept for 262 and 269 days and then placed on bullocks. They attached readily and 9 and 29 females, respectively, dropped replete. The animals reacted after 15 and 18 days, and eventually died. Piroplasms were present in smears from both. Post-mortem findings are described. Because of the reluctance of larvae to feed on cattle, attempts to discover whether the parasite could pass through the eggs of infected females to their offspring were unsuccessful.

It is concluded that although *R. neavei* may be considered as efficient a vector of African coast fever as *R. appendiculatus* under laboratory conditions, the part it plays in nature is not established. In nearly all the parts of Kenya where cattle are commonly infested with *R. neavei* in the absence of *R. appendiculatus*, the disease does not appear to exist, even in a mild form. However, if Zumpt is right in considering *R. neavei* as merely an aberrant form of *R. appendiculatus*, the whole of Kenya must be regarded as a potential endemic area, unless the development and transmission of *T. parva* is governed by some agency other than the tick.

Bishop (A.) & Gilchrist (B. M.). **Experiments upon the Feeding of *Aëdes aegypti* through Animal Membranes with a View to applying this Method to the Chemotherapy of Malaria.**—*Parasitology* **37** no. 1–2 pp. 85–100, 2 figs., 25 refs. London, 1946.

The following is based almost entirely on the authors' summary of experimental results, many of which have already been noticed from a briefer preliminary paper [*R.A.E.*, B **33** 95]. Females of *Aëdes aegypti*, L., may be induced to engorge through membranes prepared from the skin of young chicks. The proportion that will engorge through membranes under suitable conditions, though more variable than the proportion engorging when a living chick is offered, is great enough for experimental purposes. The rate of engorgement was first consistently high when females were 72–96 hours old.

The gorging reaction was provoked by a heat gradient between the environment and the food-limiting membrane. Moistening the outside of the membrane with saliva was eventually found to have little effect [*cf. loc. cit.*]. In a study of the feeding reactions of *A. aegypti* to whole blood, fractions of blood and other substances, it was found that whole blood and red corpuscles in saline when ingested through membranes go directly into the stomach which becomes fully distended; haemoglobin in plasma or distilled water is ingested to a smaller degree than whole blood or red corpuscles in saline, and plasma alone is rarely ingested, but all these pass to the stomach. Sweet solutions containing glucose or honey are seldom imbibed through membranes and pass to the stomach or diverticula, but only the diverticula are fully distended. When offered as open drops, blood is seldom ingested, but if ingested passes to the stomach; haemoglobin in plasma or water, and plasma alone, are very rarely ingested but pass mainly to the stomach; sweet solutions containing honey or glucose or mixtures of blood and honey are readily ingested and pass mainly to the diverticula (which become fully distended) though traces may be found in the stomach.

Females of *A. aegypti* can be infected with *Plasmodium gallinaceum* by allowing them to gorge on drawn infected chicken blood through a membrane, and infection rates comparable with those when the mosquitos are fed directly on living chickens can be obtained. If infected mosquitos are allowed to gorge on uninfected blood through membranes, they eject viable sporozoites into the blood. When young chicks are injected intravenously with blood so infected, infections are produced that are comparable in period of incubation and intensity with those resulting from the bites of infected mosquitos.

The ejection of sporozoites through membranes in this way provides a ready means of obtaining sporozoites free from glandular tissue. They will be suitable for *in vitro* experiments on the action of drugs on sporozoites and as a source of material for studying in tissue cultures the developmental stages of the malaria parasite arising directly from the sporozoite.

Moore (J. A.), Young (M. D.), Hardman (N. H.) & Stubbs (T. H.). **Studies on imported Malarias: 2. Ability of California Anophelines to transmit Malarias of foreign Origin and other Considerations.**—*J. nat. Malar. Soc.* **4** no. 4 pp. 307–329, 13 refs. Tallahassee, Fla., 1945.

In this report, the second in a series of which the first comprised a general record of results obtained up to the end of September 1944 in several laboratories [*R.A.E.*, B **35** 49], a detailed account is given of studies between November 1943 and December 1944 in a laboratory at San Francisco on the ability of Californian Anophelines to transmit malaria of foreign origin. The following is based on the authors' summary. Mosquitos were fed on 64 soldiers suffering from relapses of malaria acquired abroad and on nine patients in whom malaria caused by *Plasmodium vivax* of foreign origin had been induced. In all, 89 feedings were made and 11,592 mosquitos (79 per cent.) fed out of 14,640 applied. The infections in the soldiers comprised 63 with *P. vivax* and one with *P. falciparum*; one of the *vivax* infections originated in the Mediterranean area and did not infect mosquitos; all other infections were from the South Pacific. *Anopheles maculipennis freeborni*, Aitken, was the standard testing species. Of 64 lots fed on the 62 relapsing *vivax* cases from the South Pacific, 48 became infected. In these 48 lots, 2,711 examples were dissected and 1,428 (52·67 per cent.) were found infected. In a comparison of the infectivity to *A. m. freeborni* of induced infections with seven different South-Pacific strains and the same infections in relapsing soldiers, rates were relatively high in all

trials but generally higher in the induced infections than in the relapses, the average percentages of mosquitos infected being 82·9 and 66·3, respectively.

The infectivity of Pacific *vivax* malarias to *A. m. freeborni*, *A. punctipennis*, Say, *A. m. occidentalis*, D. & K., and *A. pseudopunctipennis franciscanus*, McCracken, was compared. All species developed sporozoites and appeared to be about equally susceptibile. The length of the sporogonous cycle in these four species at 75°F. was about 10 days. The shortest cycle observed was eight days in *A. m. freeborni*. Imported *vivax* malaria was transmitted by *A. m. freeborni*, *A. punctipennis* and *A. m. occidentalis*, 17 different infections being transmitted to 21 patients. Two other patients who did not acquire the infection were negroes who had had malaria before.

At Marysville, California, infections developed in mosquitos kept at outside temperatures during late September and most of October, but much more slowly than in those kept at 75°F. In San Francisco, the infections did not develop over a period of 19 days ; however, when the mosquitos were transferred to 75°F., these infections developed, showing they were still viable. Thus foreign malarias might be expected to spread in areas with a climate similar to that of Marysville, particularly in the warmer months, but not in San Francisco, as the observations there were made in what is usually the warmest part of the year. The maximum, minimum and mean temperatures during the period in question were 72–99, 50–59 and 62–80°F., respectively, at Sacramento (corresponding to Marysville), and 58–76, 50–58 and 54–64°F., at San Francisco.

The gametocyte count in soldiers having relapses of *vivax* malaria averaged 4·5 per 100 white blood cells and ranged from 0 to 32 (0 to 1,440 per cu. mm.). Two lots of mosquitos were infected when no gametocytes were seen ; conversely, the highest gametocyte count did not infect. Infections in *A. m. freeborni* occurred most frequently when there were 1–15 gametocytes per 100 w.b.c. Infection usually occurred when exflagellation was demonstrated, but it also occurred frequently when no exflagellation was seen. In general, gametocytes were produced as long as relapses occurred, and mosquitos were infected on patients with the 17th relapse. The usual number of oöcysts upon the guts of infected females of *A. m. freeborni* was 1–24, and of sporozoites in the glands 10–100. In five cases, all probably from Guadalcanal, guts showed several hundred oöcysts ; one had approximately 800. In the females with these heavy gut infections the gland infections were correspondingly high. In four instances, *A. m. freeborni* became infected when applied after malaria therapy with quinine or atabrine had begun. Three of these were *P. vivax* and one *P. falciparum*. The *vivax* malarias were infective to the field-caught as well as to the laboratory-reared females of *A. m. freeborni*. It was concluded that control measures were required to combat the foreign malarias introduced to the west coast of the United States by relapsing carriers.

Causey (O. R.), Deane (L. M.) & Deane (M. P.). **Description of *Chagasia rozeboomi*, an Anopheline from Ceará, Brazil.**—*J. nat. Malar. Soc.* **4** no. 4 pp. 341–350, 24 figs., 7 refs. Tallahassee, Fla., 1945.

The larvae, pupae, adult females and male genitalia of *Chagasia rozeboomi*, Causey, Deane & Deane, are described for the first time, and the egg is redescribed [*cf. R.A.E.*, B **32** 182]. A table is given of the characters differentiating adults and larvae of the four known species of *Chagasia*, *C. fajardoi*, Lutz, *C. rozeboomi*, *C. bonneae*, Root, and *C. bathanus*, Dyar, and the eggs of the first two. The first three have been taken in Brazil. *C. rozeboomi* was found in high wooded areas in the state of Ceará, at about 1,650 ft. above sea

level. The larvae were taken in small numbers in shaded forest springs or in the streams arising from them, in clear, cool, moving water with some marginal vegetation and thick deposits of fallen leaves. Adults rarely if ever entered houses; they were caught out of doors, usually at sunset, on both man and horses, but appeared to prefer man.

BUSVINE (J. R.). **The comparative Toxicity of various contact Insecticides to the Louse** (*Pediculus humanus* **L.**) **and the Bed-bug** (*Cimex lectularius* **L.**).—*Ann. appl. Biol.* **33** no. 3 pp. 271–279, 27 refs. London, 1946.

An account is given of laboratory tests of various substances against *Cimex lectularius*, L., and *Pediculus humanus humanus*, L. [*cf. R.A.E.*, B **33** 191], made with the object of obtaining quantitative data on their insecticidal values. The lice were reared in gauze-bottomed boxes kept against the skin of the leg during the day; the bed-bugs were kept in muslin-topped glass tubes at 23°C. [73·4°F.] and allowed to feed weekly on the ears of a rabbit. According to their physical properties, the substances were tested as sprays, dips or powders. Oil-soluble insecticides were dissolved in refined white oil and sprayed on to the insects with a hypodermic syringe in Potter's apparatus [*cf.* A **29** 591]. The test insects were exposed in small glass dishes with filter paper in the bottom to absorb excess spray. The insecticidal concentrations were varied, while the volume of liquid was kept constant at 1 cc. The average deposit was 0·36 mg. liquid per sq. cm., at which rate the oil carrier was harmless to the insects. Some spray tests were also made with aqueous solutions and emulsions; in this case a larger volume was used. Dipping tests were made with lice and their eggs, the former being dipped while clinging to pieces of tape and the latter attached to the tapes on which they had been laid. After exposure, they were dried on blotting paper and aired for five minutes in a stream of air. Solids of low solubility in both oil and water were tested as powders, alone or with kaolin. Lice were put into tins with pieces of tape into which the dusts had been rubbed, and bed-bugs were shaken up with the powders and then allowed to crawl on to paper slips, which were tapped briskly to remove excess dust. After treatment the lice were returned to their boxes and the bugs put into clean tubes at 20°C. [68°F.]. Final mortalities were determined after three and seven days, respectively, the different intervals being necessary because the lice, on the leg, were at a higher temperature and reacted more quickly than the bugs.

The most precise results were yielded by the spray method; they are examined statistically and shown in tables. The chemical composition of the substances used is given. The median lethal concentrations (per cent.) for the oil-soluble insecticides against lice and (in brackets) bed-bugs were 0·016 (0·051) for the pure γ isomer of benzene hexachloride, 0·3 (0·56) for DDT, 0·038 (0·026) and 0·47 (0·045) for pyrethrins with and without 2 per cent. undecyleneamide, 1·5–8·1 (4–32) for four thiocyanates, 3·2 (75) for Thanite [B **36** 165], 6·2 (75) for dixanthogen (bisethylxanthogen) and 21 (75) for benzyl benzoate. The second set of spray tests was made against lice with a water solution of formaldehyde and emulsions prepared by diluting lysol, a stock emulsion containing 25 per cent. lauryl thiocyanate and 5 per cent. triethanolamine stearate, and one containing 1 per cent. rotenone (in 7 per cent. derris) and 30 per cent. castor oil. The approximate median lethal concentrations for rotenone, lauryl thiocyanate, formaldehyde and lysol when sprayed at 1·8 mg. of liquid per sq. cm., were 0·15, 0·5, 9 and 12 per cent., respectively, against the adults and for the last three materials, 1, 25 and 5 per cent. against the eggs. The median lethal concentration against lice of lauryl thiocyanate applied as a solution in oil at 0·36 mg. per sq. cm. was 6 per cent.

The non-aqueous liquids used in the dip tests were perchlorethylene, trichlorethylene and white spirit, which are used in "dry-cleaning" clothes,

kerosene, xylene, and a range of other petroleum-oil fractions included for comparison with kerosene and white spirit. The specifications of these fractions are given. The table of results shows immersion times for complete kill of adults, first nymphs and eggs of *P. humanus*, and the various symptoms observed. The times for adults and nymphs ranged from 5 to 60 minutes, and those for eggs from 2 to over 24 hours. Microscopic examination of the lice during immersion showed different types of toxic action. All the volatile fat-solvent liquids rapidly caused obvious signs of injury, apparently by a physical action, while refined paraffin-oils of high boiling-point acted mechanically by occluding the respiratory system. The more viscous oils did not so easily invade the finer tracheae of the nymphs, which therefore appeared markedly more resistant than the adults [*cf.* B **34** 185] ; and kerosene, although penetrating both stages rapidly and completely, dried out more readily from the bodies of the nymphs. Some of the unrefined kerosene samples had a mixed mechanical and physical action, owing to their aromatic constituents. A mixture of alcohol and white spirit showed a synergistic action, being far more toxic than either ingredient alone [*cf.* B **29** 80], to all stages. When mixtures of the two in various proportions were tested against eggs, a 50 : 50 mixture was found to be the most toxic.

The aqueous preparations used in dips were two concentrations each of lysol, formaldehyde and mercuric chloride, and a quassia infusion. The most effective against adults and nymphs was 10 per cent. lysol (15 and 20 mins. dipping time for complete kill, respectively) ; both this and 2 per cent. lysol killed the eggs in less than 5 minutes. Mercuric chloride was also more lethal to eggs than to the free stages.

Of the more promising of the materials tested as dusts, γ benzene hexachloride, DDT and rotenone gave complete kill of adult lice at concentrations of 0·01, 1 and 1 per cent. and 100, 100 and 75 per cent. kill of adult bugs at 0·1, 5 and 1 per cent., respectively, but had no action on louse eggs. AL 63 [*cf.* B **29** 117, 121 ; **34** 46], which contains both rotenone and naphthalene, gave a complete kill of eggs as well as of adult lice, and 83 per cent. kill of bugs. Undiluted diphenylamine and 10 per cent. lauryl thiocyanate gave complete kill of bugs, lice and louse eggs and undiluted dinitroanisole gave complete kill of lice and their eggs but only 33 per cent. kill of bugs.

Experiments were also made with extracts of seeds of *Delphinium*, comprising oils containing or free from alkaloids, oil-soluble alkaloids, and water-soluble alkaloid hydrochlorides. Five species or varieties were available for testing, and all had some insecticidal power. Detailed results are given in tables. Spray tests against adult lice with various concentrations of oils containing alkaloids and of alkaloid-free oils showed that the median lethal concentrations, calculated graphically, were approximately 5 per cent. for the former and 50 per cent. for the latter, while that of the oil-soluble fraction of the alkaloids extracted from one sample was less than 0·5 per cent. As bed-bugs were found to be highly resistant to the delphinium-oil sprays, they were tested by applying droplets (0·4 mg.) of alcoholic solutions to their backs with a micro-pipette, but even these were ineffective except at very high concentrations. All lice immersed for 5 minutes in 5 or 2·5 per cent. aqueous solutions of alkaloid hydrochlorides were killed, but mortality of louse eggs was very low. In a spray experiment carried out by W. A. L. David, a 5 per cent. solution of delphinium oil containing alkaloids gave a negligible kill of *Aëdes aegypti*, L.

It is concluded that the power of delphinium extracts as contact insecticides is mainly in the alkaloids. When concentrated, however, these are rather highly toxic to man, so that their use is not recommended when the new synthetic insecticides are readily available.

PAPERS NOTICED BY TITLE ONLY.

BRUES (C. T.). **Insects & Human Welfare. An Account of the more important Relations of Insects to the Health of Man, to Agriculture, and to Forestry.**—Revd. edn., $8\frac{1}{2} \times 5\frac{1}{2}$ ins., xiii—154 pp., 14 figs. Cambridge, Mass., Harvard Univ. Pr.; London, Geoffrey Cumberlege, 1947. Price $2.50 or 14*s*. [For original edition, see *R.A.E.*, B **9** 169.]

SCHECHTER (M. S.), HALLER (H. L.) & POGORELSKIN (M. A.). **Colorimetric Determination of DDT in Milk.**—*Agric. Chem.* **1** no. 6 pp. 27, 46, 20 refs. New York, N.Y., 1946. [See *R.A.E.*, A **36** 393.]

PROVERBS (M. D.) & MORRISON (F. O.). **The relative insecticidal Activities of DDT and related organic Molecules.**—*Canad. J. Res.* (D) **25** no. 1 pp. 12–44, 19 figs., 20 refs. Ottawa, 1947. [See *R.A.E.*, A **36** 421.]

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